Water Resource Report 37

1973

SUMMARY GROUND-WATER RESOURCES OF WESTMORELAND COUNTY, PENNSYLVANIA

by Thomas G. Newport

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF
TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

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SUMMARY GROUND-WATER RESOURCES OF WESTMORELAND COUNTY, PENNSYLVANIA

by Thomas G. Newport
U. S. Geological Survey

Prepared by the United States Geological Survey, Water Resources Division, in cooperation with the Pennsylvania Geological Survey

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PREFACE

This report is presented as a comprehensive description and inventory of the ground-water resources available in Westmoreland County. With the continuing growth of our population and expansion of our industries, there is an ever increasing rise in demand for quality water resources. Ground water, or subsurface water, constitutes one of the largest reserves of quality water remaining to be developed.

This report can be of assistance to anyone who is planning for future water needs. It will help to evaluate the quantity and quality of ground water available in any part of the county, and it will aid in choosing the locations, depths and conditions most favorable for the desired ground-water yield.

While this publication has attempted to include all available ground-water data for the county, the Pennsylvania Topographic and Geologic Survey will continue to collect ground-water and water-well data for the area; such data will be kept on open file at the Survey offices in Harrisburg, available to anyone who desires the very latest information.

We hope that this report will aid users of water in Westmoreland County to develop and manage their water resources so as to accommodate their water needs.

ARTHUR A. SOCOLOW

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SUMMARY GROUND-WATER RESOURCES OF WESTMORELAND COUNTY, PENNSYLVANIA

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Thomas G. Newport

ABSTRACT

The geologic units in Westmoreland County range from the Mississippian Pocono Group to Quaternary alluvium. The alluvium overlies bedrock in the major stream valleys in the county. The yields of wells drilled from 15 to 85 feet in the alluvium range from 15 to 700 gpm and average 230 gpm. Of the consolidated aquifers, the Pennsylvanian Conemaugh and Allegheny Groups yield small to moderate supplies of water. The Pottsville Group has yields of 20 to 500 gpm, depending on whether the wells penetrate the full thickness of the sandstone. The Mississippian Pocono Group is deeply buried throughout most of the county, but in its outcrop areas there are many hillside springs which yield 5 to 100 gpm.

Chemical analyses show that many samples are high in iron content. In the western part of the county, salt water is a problem; any well deeper than 50 or 100 feet below the level of the major streams will encounter water that contains high concentrations of chloride.

No recent inventory of commercial and industrial water supplies has been made in Westmoreland County, but the amount of ground water used for most purposes has probably decreased due to improved plant design and to the use of more efficient manufacturing techniques. Since there is relatively little use of ground water in the county, there is no known overdraft.

The greatest water problem in the county is the contamination of water resources by drainage from coal-mining operations. Also, collapse of roof materials in worked-out coal mines has caused fracturing and dewatering of the overlying aquifers in some parts of the county. Other sources of pollution are the numerous oil and gas wells that were abandoned but not properly plugged. Many of the well casings have been removed or severely corroded, allowing salt water to rise in the boreholes and contaminate shallow fresh-water aquifers.

INTRODUCTION

PURPOSE AND SCOPE

This report is part of a program to summarize the ground-water resources of Pennsylvania in a series of county reports that will be easy to read and suitable for widespread distribution. It contains a general description of the aquifers in the county, a geologic and well-location map, and data on the depth and yield of wells and the chemical quality of ground water.

LOCATION AND GENERAL GEOGRAPHIC FEATURES

Westmoreland County occupies an area of 1,040 square miles at the northeast end of the soft coal fields in southwestern Pennsylvania (Figure 1). It is bordered on the north by Armstrong and Indiana Counties, on the east by Cambria and Somerset Counties, on the south by Fayette County, and on the west by Allegheny and Washington Counties. Greensburg, the county seat, is 25 miles southeast of Pittsburgh and 140 miles west of Harrisburg.

Westmoreland County is in the Appalachian Plateaus physiographic province. The western two-thirds is characterized by rounded hills or ridges and broad stream valleys. The eastern one-third is dominated by three northeast-southwest trending land forms: Chestnut Ridge (east), Ligonier Valley (central) and Laurel Hill (west).

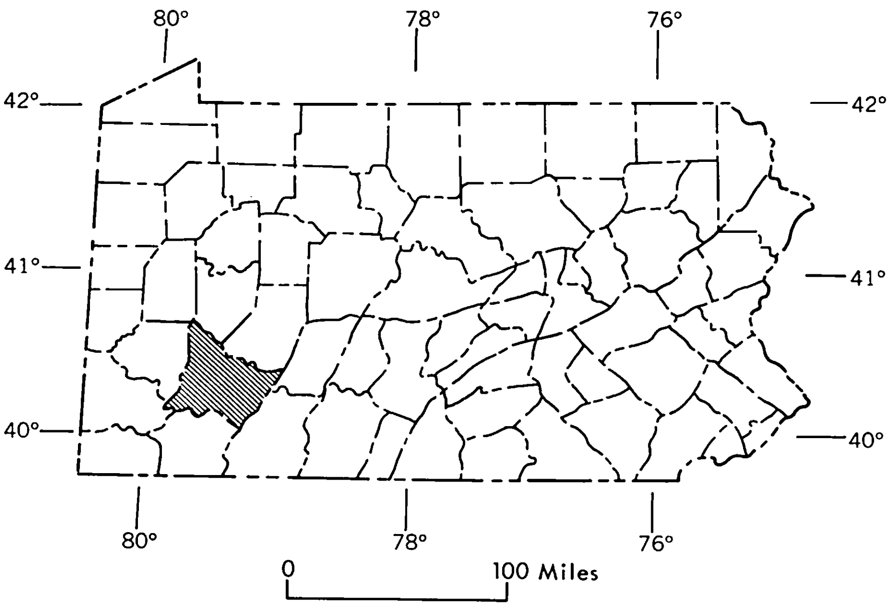


Figure 1. Map showing location of Westmoreland County in Pennsylvania.

The Kiskiminetas and Allegheny Rivers drain the northern part of the county. The Monongahela and Youghiogheny Rivers drain the western part. The Allegheny Mountain section is drained by tributaries of the Conemaugh River and Loyalhanna Creek.

POPULATION TRENDS

The total population of Westmoreland County increased from 160,175 to 376,935 in the last 70 years. Table 1 gives the census figures for the population from 1900 to 1970.

The 1970 population density is 362 persons per square mile. The population density per square mile ranges from about 4 to 6,000.

Table 1. *Population of Westmoreland County, 1900-1970*

Year	Population
1900	160,175
1910	231,304
1920	273,568
1930	294,995
1940	303,411
1950	313,179
1960	352,625
1970	376,935

LAND USE IN THE 1960'S

About 39 percent of the total land area of the county is occupied by farms. Woodlands cover 36 percent, and the remainder is used for strip mines and urban or industrial development.

Most of the farms produce dairy and poultry products. The largest industries are steel production and coal mining.

WHERE THE WATER COMES FROM

HYDROLOGIC CYCLE

Water is one of our most important resources, and it constitutes the major part of most living things. Man's existence depends upon it, yet water supplies are taken for granted by most individuals. As shown in Figure 2, water evaporates from the oceans and is carried as vapor until it condenses and falls. Most of the precipitation on the land either is used by vegetation, evaporates back to the atmosphere, or runs overland as streamflow. Part enters the soil and bedrock to recharge water-bearing formations, called aquifers. The water moves at a varying pace, depending on its environment, but eventually it returns to the oceans.

If man interrupts or changes the hydrologic cycle he may cause effects that last for many years. Man-made changes in the hydrologic cycle in Westmoreland County are discussed in the following pages.

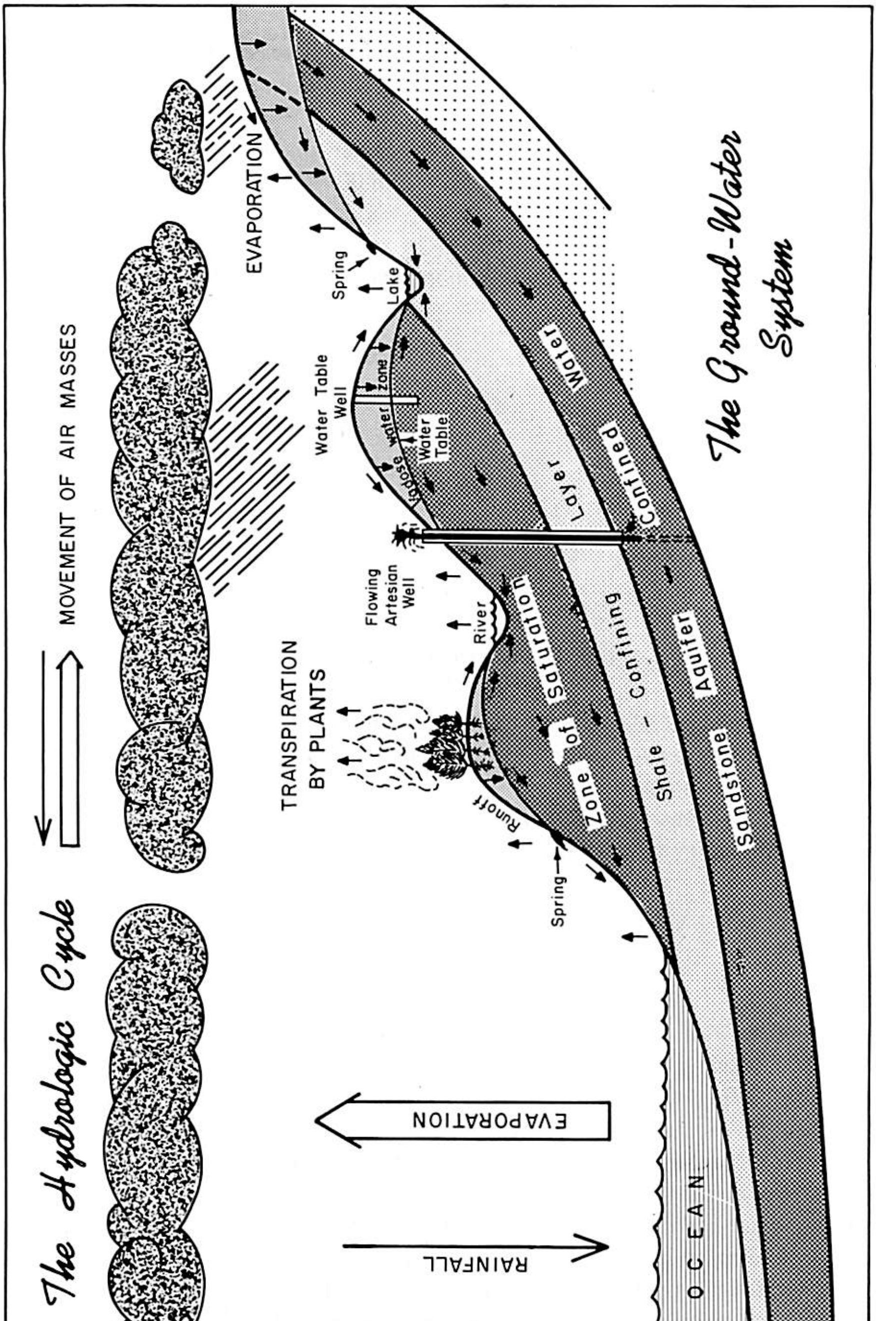


Figure 2. Hydrologic cycle, showing movement of water from ocean to land and back to the ocean.

PRECIPITATION

Precipitation is the source of all fresh water in the county. Some streams carry in runoff from areas outside the political boundaries. Annual precipitation normally ranges from 40 inches in the western part to more than 50 inches in the eastern part.

Precipitation is generally well distributed throughout the year, but the summer has a little more rainfall than the other seasons. Much of the summer rain falls during storms of short duration. About one-fifth of the total precipitation is snow.

WHERE THE WATER GOES

EVAPOTRANSPIRATION

Evapotranspiration is a collective term describing the return, through the sun's energy, of water to the atmosphere as vapor. In the process of transpiration, soil moisture returns to the atmosphere as a by-product of plant growth. In the evaporation process, water changes directly from a liquid to a vapor.

The mean annual rate of evaporation from surface-water bodies in Westmoreland County is estimated to be 28 inches. The surface area of water bodies in Westmoreland is small, and the water evaporated from them contributes little to the hydrologic cycle. However, the total annual water evaporated and transpired over the entire area is about 24 inches.

STREAMFLOW

Most of the water not lost through evapotranspiration leaves the county as discharge from streams. This discharge accounts for 20 to 25 inches of the original annual precipitation on the area. The larger streams and the locations of gaging stations that measure their flow in Westmoreland County are shown in Plate 1. Identification numbers are those assigned by the U.S. Geological Survey. A summary of discharge data for these gaging stations is given in Table 2. More detailed information on streamflow can be obtained from *Surface Water Records for Pennsylvania,* U.S. Geological Survey, 1969.

Table 2. *Discharge Data for the Gaged Streams in Westmoreland County*

Conemaugh River at Seward, Pa. 3-0415

Average discharge, 31 years of record: 1,203 cfs*

Maximum discharge, October 16, 1954: 54,000 cfs

Minimum discharge: not determined

Table 2. *(Continued)*

Loyalhanna Creek at Kingston, Pa. 3-0450
- Average discharge, 30 years of record: 286 cfs
- Maximum discharge, October 15, 1954: 29,700 cfs
- Minimum discharge, September 4, 1953: 0.1 cfs

Loyalhanna Creek at Loyalhanna Creek Dam, Pa. 3-0470
- Average discharge, 30 years of record: 453 cfs
- Maximum discharge, June 5, 1941: 11,700 cfs
- Minimum discharge, October 9, 10, 15, 16, 22-24, 1947: 0.2 cfs

Kiskiminetas River at Vandergrift, Pa. 3-0485
- Average discharge, 32 years of record: 2,913 cfs
- Maximum discharge, March 31, 1940: 71,900 cfs
- Minimum discharge, October 15, 16, 1952: 56 cfs

Monongahela River at Charleroi, Pa. 3-0750
- Average discharge, 36 years of record: 8,772 cfs
- Maximum discharge, March 7, 1967: 158,000 cfs
- Minimum discharge: not determined

*Cubic feet per second

GROUND WATER

Much of the precipitation on the land surface returns to the atmosphere or reaches streams as overland runoff. Part infiltrates the soil and fractures and other void spaces in the underlying rock. Its downward movement continues until it reaches the zone of saturation, a zone in which all the interconnected voids are filled with water (Figure 3). After reaching the zone of saturation, the water moves downward and laterally toward lower elevations and eventually returns to the surface, either naturally from springs or from wells.

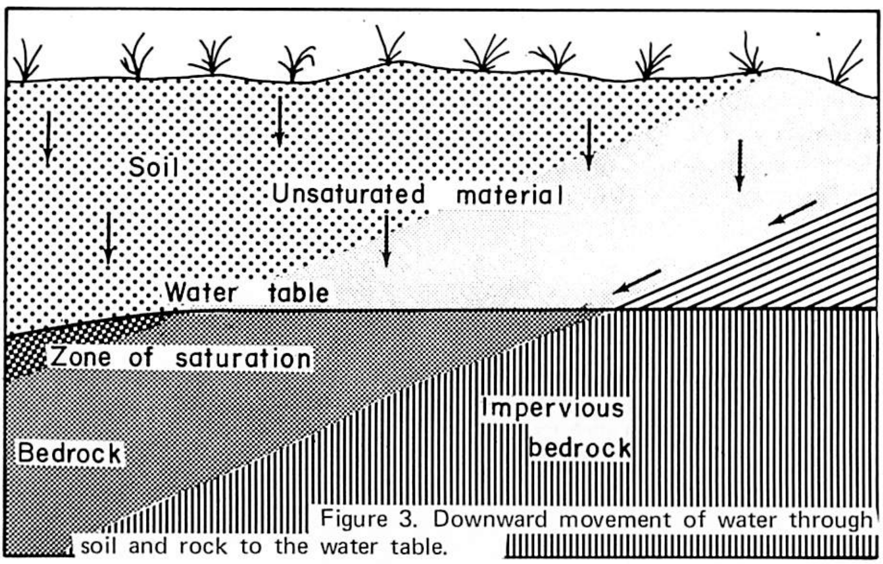


Figure 3. Downward movement of water through soil and rock to the water table.

Ground water occurs under both water-table and artesian conditions. Water-table conditions are those in which ground water is unconfined, and the upper surface of the water is free to rise or fall. Artesian conditions exist where the water is confined in a permeable (having interconnected openings) formation that is overlain by a relatively impermeable formation. The upper surface is not free to rise or fall, but the water is under enough pressure to rise above the containing aquifer where it is penetrated by wells. The imaginary surface to which water will rise in wells tapping an artesian aquifer is called the potentiometric surface.

The water table fluctuates according to the relative amounts of recharge (additions to the aquifer) and discharge (losses from the aquifer to springs and wells). Because of heavy evapotranspiration during the growing season (April to October), recharge to the zone of saturation is much less than discharge from it, and water levels decline. Water levels generally rise throughout the rest of the year, when recharge exceeds discharge. A hydrograph of a well in State Game Lands in the eastern part of the county is shown in Figure 4. This hydrograph illustrates the changes in ground-water levels from 1968 through 1970.

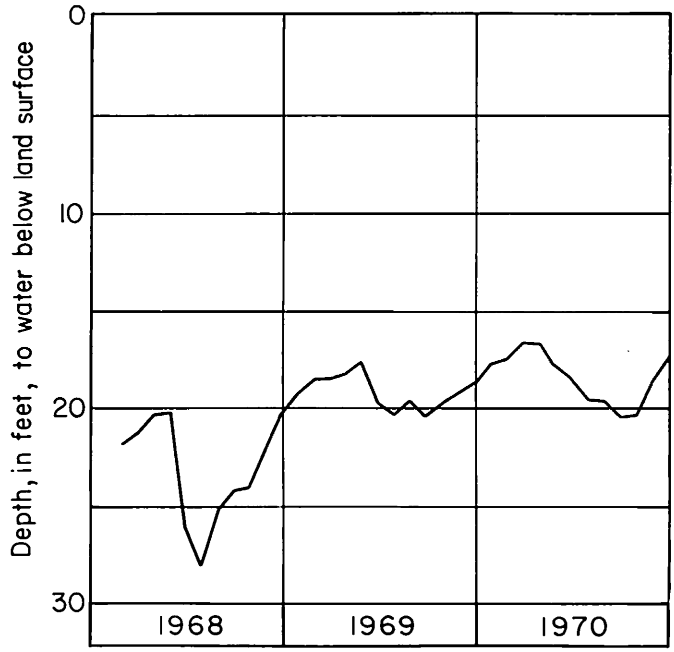
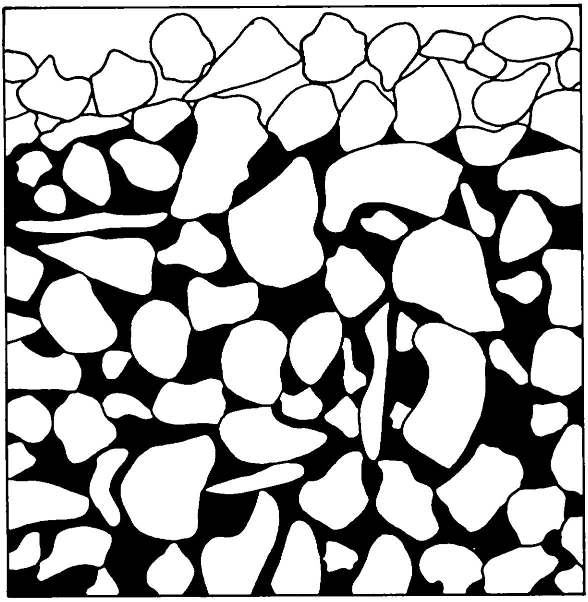


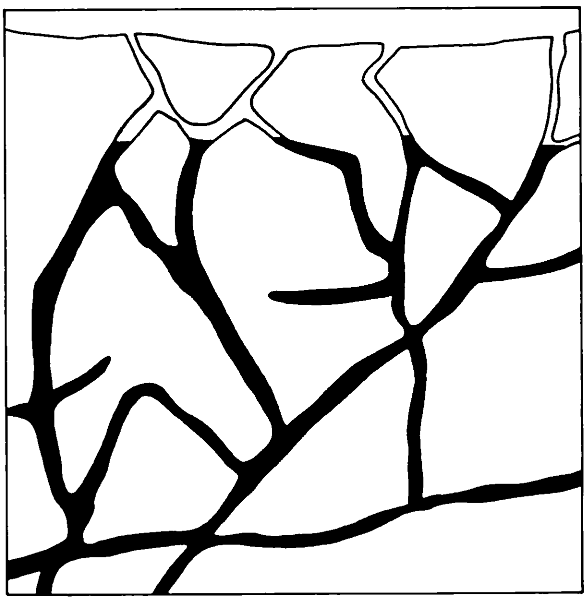
Figure 4. Hydrograph of well We-300, in State Game Lands area number 42.

Water levels in the county are at or near the land surface in the valleys and rise under the hilltops and ridges. The rate of water-level rise, however, is less than that of the land surface, so depths to water at higher elevations are greater than those in the valleys.



Sand |←0.01'→|

Primary openings in unconsolidated material



Creviced rock |←10'→|

Secondary openings in consolidated rock

Figure 5. How water occurs in the rocks.

Table 3. *Chemical Analyses of Ground Water from Wells in Westmoreland County*

Well Number	Date of collection	Temperature (°F)	Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$ Calcium magnesium	Hardness as $CaCO_3$ Non-carbonate	Specific conductance (micromhos 25°C)	pH	Color
We- 7	--	52	17	.17	–	40	13	43	1.3	261	18	9	–	0.6	262	–	153	–	–	–
12	1926	56	9.8	108	–	51	13	22	1.8	43	119	44	–	0.0	299	–	181	–	–	–
20	--	–	.1	---	–	–	–	4	–	–	–	–	–	–	22	–	–	–	–	–
21	--	58	16	.23	–	5.2	1.5	131	2.9	224	4.0	86	–	.1	368	–	19	–	–	–
25	--	52	19	.79	–	84	25	7.1	.8	273	72	18	–	.25	371	–	312	–	–	–
31	--	52	16	.68	–	74	19	7.0	1.7	315	10	3.6	–	.05	280	–	263	–	–	–
61	--	52	21	.08	–	26	9.7	71	1.3	270	35	10	–	.05	292	–	105	–	–	–
85	--	50	12	1.8	–	8.6	3.3	21	1.4	59	16	10	–	.1	102	–	35	–	–	–
92	--	51	8.3	.52	–	2.9	1.4	253	4.5	341	202	66	–	1.2	722	–	13	–	–	–
101	--	53	12	.54	–	3.7	1.4	211	3.2	469	62	29	–	.50	565	–	15	–	–	–
102	--	51	9	.08	–	81	6.2	2.7	.7	209	42	14	–	8.3	272	–	228	–	–	–
112	--	52	18	1.1	–	47	13	11	1.1	217	2.6	8.0	–	.0	201	–	171	–	–	–
127	--	56	13	8.2	–	98	24	403	9.2	293	85	644	–	1.0	1449	–	343	–	–	–
132	--	53	17	14	–	74	18	17	2.1	149	129	24	–	1.1	374	–	259	–	–	–
136	--	52	16	.55	–	40	9.5	31	.7	206	18	9	–	.53	224	–	139	–	–	–
142	--	49	20	23.2	–	16	6.5	5	1	54	26	2.7	–	.29	99	–	67	–	–	–
147	--	50	10	4.1	–	24	6.2	5	1	70	23	4	–	4.5	115	–	85	–	–	–
150	--	52	17	.36	–	40	9.0	26	1	190	21	6.2	–	.29	211	–	137	–	–	–
153	1941	57	–	3.4	–	–	–	–	–	–	–	--	–	--	–	–	527	–	6.8	–

Table 3. *(Continued)*

Well Number	Date of collection	Temperature (°F)	Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos 25°C)	pH	Color
202	1948	–	30	.3	–	–	–	–	–	–	–	––	–	––	610	–	–	–	7.1	–
203	1948	–	–	35	–	76	28	–	–	–	–	––	–	––	570	–	–	–	6.9	–
233	––	56	10	5.1	–	70	27	835	12	510	4.9	1200	–	1.5	2458	–	286	–	–	–
243	1956	53	8.9	0.0	0.0	60.0	15	11	.9	218	53	4.4	.1	.4	270	33	212	–	8.2	3
300	1968	51	7.4	0.0	0.0	32	9.6	1.8	.9	132	9.6	3	.1	.5	130	120	10	282	8.3	1

Ground water occurs in and moves through interconnected openings (Figure 5) that are either primary or secondary. Primary openings are void spaces between the individual grains that compose unconsolidated sediments or sandstone and shale. The openings in unconsolidated sediments or coarse-grained sandstone are large compared with those in shale. The larger interconnecting openings allow much more ground-water movement than the smaller ones.

Secondary openings are those formed after the deposition and consolidation of the formations. In Westmoreland County they result from the fracture or solution of the rock. The fractures are the result of external forces that caused rupture of the rock. Solution cavities are formed by the solution and removal by water of parts of rocks, such as limestone. Large quantities of water move through some interconnected fractures and solution cavities.

GROUND-WATER QUALITY

As precipitation enters the ground, it dissolves parts of the soil and rock. Because ground water is in contact with soil and rocks longer than surface water, it has more dissolved material in it. Some spring and well water may contain more than 500 mg/l (milligrams per liter) dissolved solids, which is not considered desirable for domestic water supplies (U.S. Department of Health, Education and Welfare, 1962), though more highly mineralized water is used where better water is not available. Ground water generally is of better quality than surface water because the soil and rocks through which it percolates tend to screen out solid suspended materials and bacteria.

Analyses of ground water from Westmoreland County are listed in Table 3. Most of the water is from the sandstone aquifers, and many samples are high in iron content. At many places in the coal fields, the beds above the coal have been drained by mining, and the beds below the coal contain water that has high concentrations of iron.

In the western part of the county salty water is a problem. In general, wells over 500 feet deep or any well deeper than 50 or 100 feet below the level of the major streams will encounter water that contains high concentrations of chloride.

HOW AND WHERE GROUND WATER IS FOUND

Ground water in Westmoreland County occurs in both artesian and water-table aquifers. The yields of wells differ widely from one geologic formation to another and within the same geologic formation. Information on the aquifers is summarized briefly in Table 4 and is explained in more detail in the following pages. Well yields range from less than 1 gpm (gallons per minute) to 700 gpm. Data on more than 250 wells drilled in the various geologic formations that underlie the county are listed in Table 5. Plate 1 shows the locations of selected wells.

Table 4. *Geologic Units in Westmoreland County*

Age	Name	Thickness (feet)	Lithologic character	Hydrologic characteristics
Quaternary Pleistocene and Holocene	Alluvium	0- 85	Well to poorly sorted deposits of clay, sand, gravel, and boulders.	Yields 15-700 gpm, depending on degree of sorting by grain size.
Permian – Pennsylvanian	Washington Formation	0-430	Variable strata of shale and sandstone, discontinuous limestone beds, and several coal beds.	Yields range from less than 1 to 22 gpm from sandstone.
Pennsylvanian	Monongahela Group	23-187	Massive and thin-bedded limestone, variable shale, discontinuous sandstone and coal beds.	Yields range from less than 1 to 15 gpm. Low yields partly the result of coal mining dewatering the rocks.
	Conemaugh Group	42-640	Primarily sandstone and shale and lesser amounts of limestone and coal.	Yields range from less than 1 to 357 gpm. Yields large enough for industrial and municipal purposes are difficult to obtain.
	Allegheny Group	30-400	Composed of shale, sandstone of variable thickness, discontinuous limestone, and coal beds.	Yields range from 2 to 550 gpm. Large yields are difficult to obtain.
	Pottsville Group	155-450	Predominately sandstone and conglomerate, and thin shale beds.	Yields range from 20 to 500 gpm. Higher yields are obtained from the deeper wells, and also water of poor quality.
Mississippian	Mauch Chunk	310	Predominately shale interbedded with limestone and sandstone.	Poor water-bearing formation.
	Pocono Group	600	Massive sandstone and some shale.	Springs in the outcrop area yield from 5 to 100 gpm.

Table 5. *Record of Wells in Westmoreland County*

Well number: Identification number that relates record in this table to well's location on map. The letter "S" following number indicates the record was obtained from the Pennsylvania Geological Survey.
Location: The number is the coordinates in degrees and minutes of the southeast corner of a 1-minute quadrangle within which the well is located.
Use: A, air conditioning; C, commercial; H, domestic; N, industrial; P, public supply; R, recreation; S, stock; U, unused.
Topographic setting: H, hilltop; S, slope; V, valley; T, terrace; C, stream channel; F, flat.
Aquifer: Qa, alluvium; IPw, Washington Formation; IPm, Monongahela Group; IPc, Conemaugh Group; IPa, Allegheny Group; IPp, Pottsville Group.
Lithology: sg, sand and gravel; l, limestone; ss, sandstone; sh, shale.
Static water level: F, flowing; +, above land surface.
Pumping data: gpm, gallons per minute; dd, drawdown; ft, feet; hr, hours.

Well	Location	Owner	Driller	Date Completed	Use	Altitude of Land Surface (feet)	Topographic setting	Aquifer/ Lithology	Total Depth Below Land Surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to Water-Bearing Zone(s) (feet)	Static Water Level: Depth Below Land Surface (feet)	Static Water Level: Date Measured	Pumping Data: Yield (gpm)	Pumping Data: dd (feet)	Pumping Data: Time (hour)
							Westmoreland County										
We- 2S	4035-7937	Hooks, Emerson	Roy L. Smith	1968	H	1060	S	IPc/sh	65	22	6	35		Apr. 1968	10		
3S	4038-7940	Garozril, Ted	Richard Frederick	1968	H	1020	S	IPc/ss	78	44	6	65		Aug. 1968	30		
5	4035-7942		E. Rittman			965	T	IPc/ss					20				
7	4035-7941	Hillcrest Country Club	R. C. Hall	1924		1010	S	IPa	140		8				10		
8	4039-7941	Carnegie Farms	R. C. Hall		H			IPc/ss	225								
11S	4034-7938	Wefers, Carl	Roy L. Smith	1968	H	1200	S	IPc/l	80	32	6	36	26	Apr. 1968	20		
12	4035-7946	U.S. Aluminum Co.	James Kinney, Jr.		N	860	T	Qa	85		18				520	35	10
12S	4034-7938	Stone, Clair	Roy L. Smith	1967	H	1160	S	IPc/sh	60	26	6	35	18	Dec. 1967	12		
13	4033-7945	National Lead & Oil Co. of Pa.			N		T	Qa/sg	55		120						
13S	4034-7938	Habets, Julien	Roy L. Smith	1968	H	1190	S	IPc/sh	80	26	6	45	20	Apr. 1968	15		
14	4010-7913	Rea, James C.	David A. Rolla	1947				Pp/ss	615	297	8	66					
15	4035-7943	Leslie	W. Klingensmith		H	1030	T	IPc/ss	70	20	6		40				
15S	4035-7937	Marks, Thomas	Roy L. Smith	1968	H	1040	S	IPc/l	70	27	6	49	39	Apr. 1968	20		
16	4035-7943	Allan, R. A.	W. Klingensmith		H	1060	T	IPc/ss	70		6						
17S	4034-7938	Truxall, Tedd G.	Roy L. Smith	1967	H	1250	S	IPc/sh	170	165	5	40, 140	65	July 1967	30	80	
18	4034-7936	Watson, R. M.	W. Klingensmith		H	1025	V	sh	72		6		35				
19S	4035-7937	Detor, William A.	Roy L. Smith	1967	H	1015	C	IPc/sh	70	24	7	45	28	May 1967	30		
20	4008-7954	Monessen Water Co.	Mr. Riggs	1900	P	780		Qa/sg	46	46	8		15				
20S	4036-7939	Hooks, Lloyd	Roy L. Smith	1967	H	1245	S	IPc/sh	170	14	7	80	94	May 1967	0.9		
21S	4036-7940	Moore, Esther	Roy L. Smith	1967	H	980	C	IPc/sh	80	20	7	67	37	July 1967	20		
22	4011-7948	Stoneman, Frank	G. H. Clark		H	1175	H	l	40		6		30				

Table 5. *Continued*

Well	Location	Owner	Driller	Date Completed	Use	Altitude of Land Surface (feet)	Topographic setting	Aquifer/ Lithology	Casing: Total Depth Below Land Surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to Water-Bearing Zone(s) (feet)	Static Water Level: Depth Below Land Surface (feet)	Static Water Level: Date Measured	Pumping Data: Yield (gpm)	Pumping Data: dd (feet)	Pumping Data: Time (hour)
Westmoreland County																	
23	4010-7945	Pittsburgh Coal Co.	Joseph P. Hedelmeyer	1925	H	775		ss	90	55	6		35		200		
24	4008-7950	Browneller, Elias	G. H. Clark		H	1050	T	sh	237	230	6		105				
24S	4039-7940	Brown, Belvin	W. F. Kerr	1967	H	1140	S	? c/ss	146		6	140	90	Apr. 1967	5	10	12
25	4007-7951	Clark, G. H.	G. H. Clark		H	940	T	? m/sh	60		6		20		10		
26	4015-7947	Pittsburgh Coal Co.	Joseph P. Hedelmeyer	1925	H	860	V	? m/sh	101	60	6		50		8		
26S	4038-7939	Smith, Harry	W. F. Kerr	1966	H	1035	S	? c/ss	72	26	6	38, 45, 54	30	Nov. 1966	6	0	16
27	4007-7950	Allen, Robert	G. H. Clark		H	925	T	? c/ss	150	25	6		30				
27S	4036-7939	Roller, Frank	Roy L. Smith	1966	H	1320	H	Pc	160		6	75	86	Jan. 1966	0.5		
28	4007-7950	Meshafegy	G. H. Clark	1919	H	925	T	? m/l	48	23	6		28				
29	4021-7915	Ridgeview Park	C. E. Finfrock	1926	H	1450	S	? a/sh	116	19	6		3		3		
29S	4038-7939	Lowman, Merle	W. F. Kerr	1966	H	1120	S	? c/ss	112	23	6	98	51	July 1966	4		
30	4017-7929	Hillview School	C. J. Markel		H	1125	S	? c/sh	89	11	6		20				
30S	4035-7939	Neale, Archie W.	Roy L. Smith	1966	H	1075	S	? c/sh	150	24	7	34	34	July 1966	2	116	
31	4025-7918	Liberty Bell Inn	C. E. Finfrock	1926	P	1125	T	? c/sh	70	20	6				28		
31S	4037-7940	Cehelly, George	Roy L. Smith	1966	H	1160	S	? c/sh	65	20	7	33, 47		July 1966	6	65	
32	4025-7920	Sundial	C. E. Finfrock	1925	P	1075	S	? c/sh	90	20	6				5		
33	4024-7923	Rushwood, Grove	C. E. Finfrock	1925	H	1205	H	? c/sh	70	20	6				4		
34S	4037-7938	Gaviggia, Sergio	Roy L. Smith	1966	H	1050	C	? c	43		6		23	May 1966	35		
35	4019-7924	Seiler, George	C. E. Finfrock	1926	R	1000	H	? c/sh	42	20	6				3		
35S	4035-7938	Stiffler, Roy L.	Roy L. Smith	1966	H	1100	S	? c/p	65	33	7	36	12	May 1966	3		
36	4018-7927	Crater, Fred	C. E. Finfrock	1924	H	1245	S	? c/sh	100	30	8		30		2		
38	4017-7927	Seger, Jay	C. E. Finfrock		U	1270	S	? c/sh	295	20	6		90				
39	4017-7927	Mountain View Hotel	C. E. Finfrock	1924	H	1345		? c/sh	120	20	6		60		2		
40	4019-7928	Alexander, Edward	C. E. Finfrock	1926	H	1200	H	? m/sh	80	20	6		40		1		
42	4013-7929	Fisher, Harry	C. E. Finfrock	1926	H	1140	H	? m/l	50	20	6		25				
44	4018-7910	Westmoreland-Connellsville Coal	C. E. Finfrock	1909	H	1375		? c/ss	311	25	8		80		56		
45S	4011-7921	Piper, Richard	Donald D. Piper	1967	H	1640	S	? a/sh	149	20	6	58, 128, 142	58	Aug. 1967	3	87	24
46	4018-8937	Kemmerer & Mayer	C. J. Markel	1926	C	1375	S	? c/sh	82	12	6		28				
46S	4009-7916	Keyser, Norman	Donald D. Piper	1966	H	1420	S	? c/sh	70	35	6	66	F	Oct. 1966	8		
47S	4013-7921	Hutter, Charles	Donald D. Piper	1966	H	1880	S	? c/sh	92	21	6	61, 88	36	Oct. 1966	12	52	24
48	4020-7933	Bender, W. Ray	C. J. Markel	1926	H	1300		? c/ss	68	12	6		30				
49	4018-7939	Adamsburg	C. J. Markel		U	1175	S	? c/l	290	85	6						
50	4017-7938	Gongara, Walter	C. J. Markel	1922	H	1100	S	? c/ss	119	12	6		40				

51	4016-7940	Kottar, Mike	C. J. Markel	1922		1050	S		? c/sh	75		6						
52	4019-7938	Laudadio, Frank	C. J. Markel	1926	H	1000	S		? c/sh	105	9	6		55				
52S	4011-7921	Piper, Paul	Donald D. Piper	1968	H	1625	S		? a/ss	132	22	6	78, 100, 129	50	June 1968	5		
53	4021-7938	Lauffer, H. Albert	C. J. Markel	1922	H	1000	V		? m/l	41	9	6		20				
56	4011-7946	American Reduction Co.	J. W. Leasure	1910	N	775	V		? c/ss	176	50	8		40		357	60	
57	4019-7943	Shipp, John H.	C. J. Markel	1924	H	1125	S		? m/l	100	11	6		80				
58	4018-7940	Diebold, Julius	C. J. Markel	1926	H	1100	S		? m/l	59	12	6		25				
59	4020-7943	Dugan, William, Mrs.	C. J. Markel	1922	H	900	V		? c/sh	112	25	6		50				
60	4019-7943	Studebaker Garage	C. J. Markel		C	1200	S		? m/l	200	20	6		160				
61	4012-7946	West Newton Water Co.	J. W. Leasure		P	770	V		? c/ss	200	35	6		25		35	25	
61S	4021-7918	Derry Twp. Grange	Donald D. Piper	1966	H	1220	S		? m/sh	106	19	6	98	86	Aug. 1966	7	18	48
64S	4024-7915	Hill, Elizabeth	Donald D. Piper	1969	H	1040	S		? m/sh	105	22	6	100	90	July 1969	15	0	24
82	4012-7946	Shaeffer	J. W. Leasure	1926	H	900	V		? m/ss	120	65	6		86		1		
82S	4007-7938	Westley Chapel	James R. Burkey		H	1250	S		? c/ss	110	30	6	65	65		600	0	
84S	4021-7906	Heming, Dave	Wilson Electric Pumps	1968	H	1185	S		? c/sh	90	20	6	30, 50	75	June 1968	12		
85	4019-7917	American Window Glass Co.		1900	N	1240	V		? p/ss	450		8		10		500		18
86	4020-7908	Schoolhouse			H	1430	H		? c/ss	100		6				5		
86S	4021-7907	Krack, Harold	Wilson Electric Pumps	1968	H	1180	S		? c/sh	75	29	6	62		May 1968	21		1
89	4014-7948	Westmoreland Brewing Co.	J. W. Leasure	1915	U	870	V		? c/ss	870		6				80		
90	4017-7943	Keystone Planning Co.	J. W. Leasure	1915	N	1000	V		? m/l	100	5	6		12		3		
91	4024-7934	Umack, Mike	Paul Jobe			1290	S		? m/sh	265		6						
92	4025-7937	Santucci, Tony	Paul Jobe	1926	H	1000	V		? c/sh	195	48	6		80		3		
93	4024-7935	Cappa, John	Paul Jobe		H	1050	S		? m/sh	120	4	6		60				
94S	4021-7910	Henderson, Ken	Wilson Electric Pumps	1966	H	1320	S		? c/sh	95	21	6	83	20	July 1966	20	10	1
95	4018-7933	Hofstoff	Paul Jobe		H	1100	S		? m/l	100	23	6		40				
96S	4028-7941	Zambo, Andrew	Roy L. Smith	1967	H	1060	S		? c	200		6	79	79	Sept. 1967	≤0.1		
97	4023-7929	Lyons, Ed.	Paul Jobe	1924	H	1050	S		? c/ss	90	20	6		50		5		
97S	4028-7941	Gulentz, John	Roy L. Smith	1967	H	1140	S		? c/sh	158	157	6	53	108	Aug. 1967	≤0.1		
98	4031-7936	Walker, Samuel	Paul Jobe		R	1250	S		? c/sh	60		6		9		25	1	
99	4028-7935	Irwin, Paul	Paul Jobe		H	1200	H		? c/sh	90	48	6		60				
100	4026-7934	Astorri Garage	Paul Jobe	1925	C	1120	V		? c/l	38	12	6		7				
101	4028-7931	Bethlehem Mines Corp.	Paul Jobe	1926	H	1020	V		? c/ss	225	105	8		85		44		
102	4024-7934	Jobe, Paul	Paul Jobe		H	1250			? c/l	75		6		10				
105	4015-7942	Hermine Schoolhouse	A. C. Dennick	1918	H	1120	H		? m/l	187	11	6		50				
106	4015-7942	Ocean Coal Co.	A. C. Dennick		H	925	S		? m/l	103		6		90				
108	4011-7944	Hunter	A. C. Dennick	1926	H	1160	H	P	? w/sh	75	20	6		20				
111	4025-7939	Parks, Fred	J. E. Berlin	1924	H	975	S		? c/ss	164		6						
112	4025-7941	Schoolhouse	J. E. Berlin	1924	P	910	V		? c/ss	74	42	6		20		11		
113	4026-7942	Peoples Natural Gas Co.	J. E. Berlin			880	T		? c/sh	95	45	6		25		4		
114	4025-7937	Secizzel, Nick	J. E. Berlin	1926		1000	V		? c/ss	140	40	6		35		5		
114S	4012-7937	Haffman, Alvin	Frank Baker	1966	H	940	S		? m/ss	70			41	23	Aug. 1966			
115	4023-7944	Crew, C. W.	J. E. Berlin	1925			V		? c/ss	250		6	35	200				
118	4010-7944	Williams, Joe	A. C. Dennick	1926	H	965	T	P	? w/sh	79	21	6		21				
119	4012-7941	Robertson, Walter	A. C. Dennick	1920	H	976	H		? c/ss	112	31	6		35				
120	4028-7941	Kane, William	J. E. Berlin	1912	H	1260	S		? c/ss	150	20	6		80		2		
121	4028-7935	Greenawalt, Samuel	J. E. Berlin	1910	H	1275			? c/ss	67	25	6		50				
123	4011-7938	Morton, Samuel	A. C. Dennick	1921	H	1200	H		? c/ss	68	8	6		20				

Table 5. *Continued*

Well	Location	Owner	Driller	Date Completed	Use	Altitude of Land Surface (feet)	Topographic setting	Aquifer/ Lithology	Total Depth Below Land Surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to Water-Bearing Zone(s) (feet)	Static Water Level: Depth Below Land Surface (feet)	Static Water Level: Date Measured	Pumping Data: Yield (gpm)	Pumping Data: dd (feet)	Pumping Data: Time (hour)
Westmoreland County																	
124	4012-7936	Geistle, Frank E.	A. C. Dennick	1926	H	980	S	P a/ss	57	16	6		20				
126	4013-7941	Lavella, John		1918	H	980		P c/sh	140		6		80				
127	4019-7936	Pennsylvania Rubber Co.	J. H. Offut	1924	N	995	V	P a/ss	250		12		60		300	80	144
128	4009-7932	H. C. Frick Coal & Coke Co.	E. T. Bierer	1926		1100	V	P m/l			20		4				
130	4011-7929	Newell	Charles Nickolson	1914	S	1210	F	P m/l	100	20	6		10				
132	4005-7935	Scottdale Ice & Coal Co.	Charles Nickolson	1918	N	1020	V	P c/ss	150	30	8		30				
133	4006-7936	American Sheet & Tin Plate			N	1025											
134	4012-7931	Hissem, Reuben	Reuben Freeman	1915	H	1075	S	P c/ss	293	98	4	291	111		5	25	1
135	4011-7927	Will G. Keck, Inc.	Reuben Freeman	1920	N	1180	V	P c/ss	65	18	4		5		50	20	22
136	4009-7924	Albert, Harry	Reuben Freeman	1912	H	1900	S	P a/ss	30		4	29	23		5		
137	4012-7925	Rodman School	Reuben Freeman	1912	P	1360	S	P a/sh	67	12	4	67	23		5		
137S	4035-7941	Menk, Robert	Roy L. Smith	1968	H	1100	S	P c	141		6		71	June 1968	2		
138	4011-7927	Ridgeview School	Reuben Freeman	1913	P	1290	S	P c/ss	48	20	4	48	12		5		
139	4010-7926	Porch, J. A.	Reuben Freeman	1915	S	1525	H	P c/sh	47	21	4	47	2		5	0	
140	4008-7924	Hoyman, M. D.	Reuben Freeman		H	1800	S	sh	44	15	4	40	18				
141	4006-7923	Hauger, Sherman	Reuben Freeman	1916	C	1840	H	P c/ss	81	5	4	81	40				
142	4009-7920	Hood, Frank	Reuben Freeman	1914	H	1780	H	sh	66	16	4		31				
142S	4036-7942	Cook, James	Roy L. Smith	1966	H	1145	H	P c	115	114	5	97	77	June 1966	10		
143	4008-7917	Carns, John	Reuben Freeman	1920	S	1775	S	P a/ss	102	12	4	40, 60, 102	16				
144	4007-7919	Cambria Trust Co.	Reuben Freeman	1916	H	1585	S	P a/ss	43	27	4	43	12		5		
145	4007-7919	Geary, George	Reuben Freeman	1916	H	1725	S	P c/ss	82	20	4	38, 80	20		6	0	2
146	4005-7921	Neiderhiser, Daniel	Reuben Freeman	1915	H	1775	H	ss	40	8	4		18				
147	4005-7921	Friedline, Jessie, Mrs.	Reuben Freeman	1917	H	1505	V	P c/sh	43	11	4		20				
148	4011-7927	William G. Keck & Sons		1900	U	1200	S	P c/ss	242	121	7		18		25		
150	4011-7927	William G. Keck & Sons		1900	N	1200	S	P c/ss	104		10		14				
151	4033-7946	Aluminum Co. of America	Layne-New York Co., Inc.	1937	N	760	V	Qa/sg	72	54	8		21	Dec. 1937	250	7	
152	4033-7946	Aluminum Co. of America	Layne-New York Co., Inc.	1938	N	760	V	Qa/sg	72	52	18		18	Sept. 1938	700	27	
153	4033-7946	Aluminum Co. of America	Layne-New York Co., Inc.	1940	N	750	V	Qa/sg	78	68	12		38	Nov. 1946	500	28	22
154	4033-7946	Aluminum Co. of America	Layne-New York Co., Inc.	1942	N	748	V	Qa/sg	83	68	12		34	Jan. 1943	500	28	6
155	4033-7946	Aluminum Co. of America	Layne-New York Co., Inc.	1948	N	760	V	Qa/sg	70	60	18		22	Apr. 1948	500	32	40
156	4033-7946	Union Spring & Mfg.			H	750	V	Qa/sg	60		6		20		15		

157	4033-7946	Union Spring & Mfg.			H	750	V	Qa/sg	60		6	20		15	
158	4033-7946	City Ice and Fuel Co.	G. E. Burgly	1939	N	750	V	Qa/sg	62		10	30		200	12
159	4033-7945	Keystone Dairy		1925	N	760	V	Qa/sg	82		12	55		75	
160	4033-7945	Keystone Dairy	Homer Thompson	1941	N	760	V	Qa/sg	84		12	55		175	
161	4033-7945	Kenmar Hotel	Pennsylvania Drilling Co.	1940	U	780		P c/ss	78	32	8	44		25	
162	4033-7945	Duquesne Mfg. Co.	Robert Hall	1915	N	790		P c/ss	90		6			10	
163	4036-7942	Braeburn Alloy Steel	Layne-New York Co., Inc.	1950	N	760	V	Qa/sg	51	36	18			400	29
164	4036-7942	Braeburn Alloy Steel	Layne-New York Co., Inc.	1950	N	760	V	Qa/sg	59	44	18			350	37
165	4036-7942	Braeburn Alloy Steel	Mr. Bear	1930	H	760	V	Qa/sg	56		6	20		50	
166	4038-7935	Hyde Park Foundry & Machine Co.		1915	N	780	V	Qa/sg	35		24			20	
167	4038-7935	Hyde Park Foundry & Machine Co.		1915	N	785	V	Qa/sg	35		24			20	
168	4035-7933	Vandergrift Ice Co.	Frank Baker	1920	N	800		P a/ss	122		6	40	June 1950	30	
169	4035-7933	Vandergrift Ice Co.	Frank Baker	1920	N	800		P a	80		8	40	June 1950	25	
170	4034-7935	Vandergrift Ice Co.			P	970		P c/ss	222		6	42	Aug. 1950	125	
171	4034-7935	Vandergrift Ice Co.		1908	P	970		P c/ss	222		6			50	
172	4034-7935	Vandergrift Ice Co.			P	970		P c/ss	223		6	42		50	
173	4034-7935	Vandergrift Ice Co.			P	970		P c/ss	224		6			50	
174	4034-7935	Vandergrift Ice Co.		1913	P	970		P c/ss	222		6			175	
175	4034-7935	Vandergrift Ice Co.		1913	P	970		P c/ss	238		6			125	
176	4034-7935	Vandergrift Ice Co.		1913	P	980		P c/ss	246		6	32	Aug. 1950	50	
177	4034-7935	Vandergrift Ice Co.		1921	P	970		P c/ss	231		6			50	
178	4034-7935	Vandergrift Ice Co.		1921	P	980		P c/ss	238		6	37	Aug. 1950	300	
179	4034-7935	Vandergrift Ice Co.			P	990		P c/ss	218		6	30	Aug. 1950	150	
180	4033-7935	Vandergrift Ice Co.		1932	P	1000		P c/ss	220		8	52	Aug. 1950	350	
181	4033-7935	Vandergrift Ice Co.		1932	P	1000		P c/ss	220		8	52	Aug. 1950	350	
182	4034-7935	Vandergrift Ice Co.	Ferguson Brothers	9144	P	980		P a/sh	265		12	230	Aug. 1950	550	
183	4031-7930	Salina Water Co.	Ira E. Bittinger	1948	P	980		P c/ss	175		6			10	
184	4031-7927	Avonmore Borough	Mr. Silvns	1910	P	900		ss	150		6	30		5	
185	4031-7927	Avonmore Borough	Mr. Silvns	1910	P	900		P c/ss	160		6	30		8	
186	4031-7927	Avonmore Borough	Mr. Silvns	1910	P	900		P c/ss	150		6	30		10	
187	4031-7927	Avonmore Borough	Jobe Brothers	1929	P	900		P c/ss	200		8	30		10	
188	4031-7927	Avonmore Borough	Mr. Silvns	1923	P	900		P c/ss	175		6	30		5	
189	4031-7927	Avonmore Borough	Mr. Silvns	1910	P	925	S	P c/ss	190		6			10	
190	4031-7927	Avonmore Borough	Jobe Brothers	1930	P	875		P c/ss	200		8			10	
191	4031-7927	Avonmore Borough	Jobe Brothers	1930	P	875		P c/ss	217		8			25	
192	4031-7927	Avonmore Borough	Jobe Brothers	1943	P	930	S	P c/ss	190		8			15	
193	4031-7927	Avonmore Borough	Jobe Brothers	1943	P	870		P c/ss	200		8			40	
194	4031-7927	Avonmore Borough		1950	P	930	S	P c/ss	200		8			25	
195	4031-7928	National Roll & Foundry		1900	N	850		P c/ss	210		8			60	
196	4031-7928	National Roll & Foundry		1900	N	850		P c/ss	210		6			60	
197	4031-7928	National Roll & Foundry	Pennsylvania Drilling Co.	1948	N	850		P c/ss	201	38	10	78	June 1948	250	
198	4023-7945	Westinghouse Electric	Pennsylvania Drilling Co.	1941	N	760		P c/ss	195		10	17	Oct. 1941	12	
199	4025-7942	Armwell Machine	Denver Humes	1945	N	890		P c/ss	70		6	12		8	
200	4025-7941	Peoples Natural Gas Co.	Thomas Jobe	1938	N	890		P c/ss	50		6	19			
201	4025-7939	Westinghouse Electric	Carl Humes	1929	N	940		P m/l	90		4	60		50	
202	4020-7939	Westinghouse Electric	Carl Humes	1948	N	940		P m/l	175		8	60		75	
203	4018-7943	Westinghouse Electric	C. W. Markel	1941	U	1080	P	P w/l	30		6	15		6	

Table 5. *Continued*

Well	Location	Owner	Driller	Date Completed	Use	Altitude of Land Surface (feet)	Topographic setting	Aquifer/ Lithology	Total Depth Below Land Surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to Water-Bearing Zone(s) (feet)	Static Water Level: Depth Below Land Surface (feet)	Static Water Level: Date Measured	Pumping Data: Yield (gpm)	Pumping Data: dd (feet)	Pumping Data: Time (hour)
Westmoreland County																	
204	4018-7943	Westinghouse Electric	C. W. Markel	1946	U	1080		? m/ss	110		8		20		6		
205	4018-7943	Westinghouse Electric	C. W. Markel	1946	U	1080		? m/ss	110		8		25		10		
205S	4012-7950	Rostrauer Airport	Fred R. Clark	1967	P	1235	S	P ? w/ss	150	20	6	75, 137	56	Apr. 1967	84	0	
206	4018-7943	Westinghouse Electric	C. W. Markel	1946	U	1080		? m/ss	100		8		20		6		
207	4015-7942	Scientific Tool & Dye		1918	U	940	T	? m/ss	23		8		9	Nov. 1949	8		
208	4019-7937	McKee Glass Co.	John Knappenberger	1935	N	990		? c/ss	250	100	4		35	Nov. 1949	225		
209	4019-7934	Joseph T. Greenhouse	John Knappenberger	1937	C	1060		? c/ss	125		6		12		30		
210	4018-7932	Manos Theater	D. L. Gilkey	1938	U	1080	S	? m/l	187	9	8						
213	4029-7925	Village of Moween		1925	P	1020		? c/ss	67		6		12		6		
214	4021-7917	Bergman's Dairy	Allen Piper	1938	C	1150		? c/ss	92		7		20		9		
215	4021-7917	Bergman's Dairy	Allen Piper	1948	C	1150		? c/ss	165		7		30		7		
216	4021-7917	Bergman's Dairy	Allen Piper	1949	C	1140		? c/ss	165		7		30		6		
217	4019-7923	Latrobe Brewing Co.	Robert Keaton	1936	N	980		? c/ss	220	20	8		15		25	200	16
218	4019-7923	Latrobe Brewing Co.	Robert Keaton	1943	N	980		? c/ss	640	20	8		5		25	100	24
219	4018-7923	Manos Theater	Paul Jobe	1940	A	1000		? c/ss	285		6		100		50		
220	4010-7936	Dillinger Distilleries		1900	U	1020		? c/ss	203		6		27	Aug. 1950	50		
221	4010-7936	Dillinger Distilleries		1935	U	1025		? c/ss	149		8				90		
221S	4024-7930	Salem Twp. Munic.	Charles M. Jobe	1968	H	1320	S	? c/ss	140	23	6	80		Feb. 1968	6		
222	4010-7936	Dillinger Distilleries	G. E. Burgly	1942	U	1020		? c/ss	210		8		18	July 1942	15		
222S	4025-7933	Overly, Mark	Charles M. Jobe	1968	H	1185	C	? c/sh	120	20	6	100		March 1968	10		
223	4010-7936	Dillinger Distilleries	Joseph P. Hedelmeyer	1944	U	1025		? c/ss	190		8				125		
224	4013-7930	Homestead Assoc. of Westmoreland	Allen Piper	1934	P	980		? c/ss	229		8		16		5		
226	4011-7927	Will G. Keck, Inc.	Glen Forney	1939	P	1200		? c/ss	180		10		F		50		
227	4011-7927	Will G. Keck, Inc.	Glen Forney	1939	C	1190		? c/ss	79		6		F		50		
228	4012-7910	Ligonier Borough	Allen Piper	1946	P	1500	V	? p/ss	155		10		F		250	21	10
230	4022-7934	Shuster, Louisa	Glen Bush	1949	H	1290	S		86		6		34				
231	4024-7932	Saul, William W.	J. E. Berlin	1950	H	1200	S		187		6		96	Oct. 1950			
232	4019-7936	Pa. Rubber Co.		1933	N	1000	V	? c/ss	280		13		50		50		
233	4019-7936	Pa. Rubber Co.	C. E. Finfrock	1930	U	1030	V	? c/ss	404		13		31	Dec. 1949	200		
235	4022-7934	Shuster, Louisa			H	1290	S		38		6		27	Oct. 1950			
236	4022-7933	Jobe Brothers	Charles M. Jobe		U	1180	S		47		6		12	Oct. 1950			
237	4010-7936	Dillinger Distilleries	G. E. Burgly	1942	U	1020	V	? c	210		8		24	Aug. 1950			
239	4013-7947	Mackintosh, R. B.	G. E. Markel	1901	H	800	S		159	24	6	80	35		15		
240	4012-7946	Pittsburgh & Lake Erie R. R.	G. E. Markel	1901	U	758	V		154	60	6	130	35		2		

241	4010-7949	Finley, Thomas G.	Oliver McLain	1897	H	1200	S	I	58		6		48				
242	4008-7944	Pittsburgh & Lake Erie R. R.	G. E. Markel	1903	H	766	V		100	25	6	40	20				
243	4031-7928	Avenmore Municipal Water Works		1949	P			P c/ss	300	30	6		150		20		
245	4012-7928	H. C. Frick Coke Co.	Meckling	1905	U	1050	S		152		10						
245S	4008-7940	Grand View Church	James R. Burkey	1969	T	1420		ss	130	22	6	15, 85	50	June 1969	3		
246	4012-7928	H. C. Frick Coke Co.	Meckling	1905	U	1050	S	ss	163		10						
246S	4011-7940	Calderone, Sam	William Dennick	1969	H	1080	S	P c/z	130	20	6	95	42	June 1969	4	73	96
247	4012-7928	Frick, H. C.	Martz – Hume	1909	P	1020			652	18	14		F				
248	4012-7926	Frick, H. C.		1899		1040	V		1000	18	10		F				
249	4013-7930	Kuhn, C. W.			H	980	V		55		6		20				
250	4013-7916	Frick, H. C.				1020	S		104		6		30				
251	4013-7931	Frick, H. C.	L. W. Reynolds	1902	H	980	V		288	30	8		F			25	
253	4013-7930	Trice, Simon				1020	V	I	35				23				
254	4013-7930	Frick, H. C.				980	V		227		8		F				
255	4012-7930	Moore Estate			H	1130	S		30								
256	4010-7931	Rumbaugh, A. C.			H	1160			127	4	8		55		15		
257	4013-7929	H. C. Frick Co.				980	V		100								
258	4012-7929	Moore Estate			H	1140	H		198		4						
259	4013-7929	Frick, H. C.			H	1160	H	I	100		6						
260	4023-7924	New Alexandria			P	1095	C	P c/sh	61	21	6				15		
261	4023-7924	New Alexandria			P	1095	V	P c/ss	78	36	6				20		
262	4023-7923	New Alexandria			P	1115	S	P c/ss	135	37	6				15		
262S	4012-7944	Republican Steel	William J. McCormick	1966	N	980	S	P m/l	330	330	4	17, 30, 60	18	Sept. 1966	10		
263	4023-7924	New Alexandria			P	1120	V	P c/ss			6				100		
264	4031-7928	Avonmore Water Co.			P	950	T	P c/ss	150	35	8		1		200		
266S	4007-7944	Lesko, John	Keystone Drilling Service	1966	H	790	V	P c/sh	55	27	7	35	20	Oct. 1966	5	35	
267S	4007-7944	Muldowney, Francis	Keystone Drilling Service	1966	H	795	V	P c/sh	55	40	7	45	12	Oct. 1966	10	3	
270S	4012-7942	Rupp, Raymond		1966	H	960	S	P m/sh	70	20	8	22, 31	21	July 1966			
271S	4012-7942	Kodrin, Carl	Harry L. Carter	1966	H	960	S	P m/sh	40	21	8	26	26	Aug. 1966	4		
287S	4015-7927	Sessie, John	Steve J. Forish	1967	H	1105	S	P c/ss	100	27	6	40, 55	24	June 1967	2	2	
294S	4033-7940	Geer, Richard	Roy L. Smith	1966	H	980	C	P c/sh	60	24	7	40	10	1966	50	30	1
299S	4029-7936	Guthrie, Ruby	Roy L. Smith	1968	H	1100	S	Qa	57		6	22	22	May 1968	50		
300	4021-7903	U.S.G.S.	Warden E. Glunt	1967		1270			110	22	6		27	June 1967	9		
300S	4029-7934	Leaghty, George	Roy L. Smith	1968	H	1245	S	P c/ss	180	19	7	39		May 1968			
301	4022-7922	Keystone State Park	William J. Glunt, Inc.		R				310						4		
302	4022-7922	Keystone State Park		1968	R				170				23	Sept. 1968	75		
303	4022-7922	Keystone State Park	Warden E. Glunt	1968	R				210						39		
304	4022-7922	Keystone State Park	Warden E. Glunt	1968	R				310						33		
305	4022-7922	Keystone State Park	Warden E. Glunt	1968	R				190						41		
310S	4029-7935	Valella, William	Roy L. Smith	1967	H	1080	C	Qa	50	24	7	30	6	May 1967	48	24	
313S	4032-7935	Slagle, James	Roy L. Smith	1967	H	1140	S	P c/sh	116	24	7	79, 90	89	July 1967	20	0	
322S	4038-7938	Tew, Floyd	Roy L. Smith	1969	H	1060	S	P c/sh	68	68	5	48		Sept. 1969	10		
323S	4036-7940	Best, John	Roy L. Smith	1969	H	1000	S	P c/ss	83	20	6	75		Oct. 1969	50	1.25	1.5
332S	4037-7936	Klingensmith, R.	Roy L. Smith	1970	H	1000	S	P c	100		6	70		June 1970	8		
351S	4024-7925	Sandort, Charles	Charles M. Jobe	1970	H	1000	S	P c/sh	140	21	6	100		Sept. 1970	5		
359S	4007-7943	Shipe	James R. Burkey		H	1055	S	P c/sh	50	28	6	15, 30			6		
385S	4021-7907	Headlee, Kenneth	Wilson Electric Pumps	1970	H	1130	S	P c/sh	90	40	6	41		Sept. 1970	20		1

GEOLOGIC STRUCTURE

The structure of the bedrock affects the occurrence of ground water. There are several major folds in the consolidated rocks in Westmoreland County. These folds trend northeastward and are part of the general structure pattern of the Appalachian Mountains. The axes of the major folds are shown in Plate 1. Water in folded rocks tends to move down the dip of the beds and, when confined by less permeable material, will build up artesian pressure. Part of the ground water in dipping beds will discharge through springs and seeps along the flanks of the synclines, where the rocks have been removed by erosion or man-made excavations or have been fractured by folding.

Fractures occur in all the consolidated rocks in Westmoreland County. A study of aerial photographs could help locate the larger fractures. As ground water can move freely through fractures, wells on fractures or at the intersections of fractures should give the highest yields.

Sample logs of wells drilled in several of the geologic units are shown in Table 6.

Table 6. *Driller's Logs of Selected Wells in Westmoreland County*

Well We-12

Owner: U.S. Aluminum Company

Description	Thickness (feet)	Depth (feet)
Gravel and sand	70	70
Gravel, cemented by iron	5	75
Gravel and sand	10	85
Bedrock	.3	85.3

Well We-13

Owner: National Lead and Oil Company

Description	Thickness (feet)	Depth (feet)
Sand, fine	20	20
Gravel, coarse; sand	35	55

Table 6. *(Continued)*

Well We-14

Owner: James C. Rea

Description	Thickness (feet)	Depth (feet)
Soil	10	10
Shale, grayish black	5	15
Shale, silty, very dark gray	15	30
Shale, very dark gray	30	60
Clay, light gray	5	65
Sandstone, fine-grained, light gray	20	85
Shale, dark gray	20	105
Sandstone, fine-grained, light gray to brownish gray, some shale lenses	75	180
Shale, very dark gray	24	204
Sandstone, very fine-grained	1	205
Shale, brownish gray to dark gray	40	245
Sandstone, very fine-grained to coarse-grained	55	300
Shale, greenish gray, sandy	10	310
Shale, red	5	315
Shale, greenish gray	10	325
Shale, red	5	330
Shale, greenish gray	35	365
Sandstone, very fine-grained, greenish gray	25	390
Shale, greenish gray	10	400
Shale, red	9	409
Limestone, greenish gray, some shell fragments	11	420
Shale, greenish gray, calcareous	5	425
Limestone, dark gray	4	429
Shale, red	7	436
Shale, greenish gray	10	446
Sandstone, fine-grained, light gray	11	457
Shale, red	32	489
Sandstone, fine-grained, light gray	16	505
Limestone, brownish gray	20	525
Limestone, light gray	90	615

Well We-26

Owner: Pittsburgh Coal Company

Description	Thickness (feet)	Depth (feet)
Soil and alluvium	60	60
Sandstone	10	70
Shale, gray, water-bearing	25	95

Table 6. *(Continued)*

Well We-34

Owner: Railway Steel Spring Company

Description	Thickness (feet)	Depth (feet)
Clay	12	12
Slate, dark gray	98	110
Sandstone	5	115
Shale	35	150
Coal	7	157
Shale and fire clay	54	211
Shale, soft	74	285
Sandstone	31	316
Shale, red and gray	70	386
Shale, soft	175	561
Sandstone	69	630

Well We-39

Owner: Mountain View Hotel

Description	Thickness (feet)	Depth (feet)
Sandstone	40	40
Slate	80	120

Well We-41

Owner: O. M. Deibler

Description	Thickness (feet)	Depth (feet)
Sandstone	30	30
Slate	30	60

Well We-44

Owner: Westmoreland-Connellsville Coal and Coke Company

Description	Thickness (feet)	Depth (feet)
Clay	20	20
Shale	8	28
Limestone	8	36
Clay	16	52

Table 6. *(Continued)*

Shale	45	97
Shale, sandy	13	110
Shale	21	131
Limestone	3	134
Shale, soft, blue gray	41	175
Sandstone	75	250
Shale, sandy	20	270
Limestone	5	275
Shale, black	8	283
Shale, blue	20	303
Shale, sandy	8	311

Well We-48

Owner: R. W. Bender

Description	Thickness (feet)	Depth (feet)
Soil	10	10
Sandstone	30	40
Shale	28	68

Well We-52

Owner: Frank Laudadio

Description	Thickness (feet)	Depth (feet)
Soil	9	9
Shale, hard	18	27
Shale, blue	25	52
Sandstone	10	62
Shale, slaty	47	105

Well We-102

Owner: Paul Jobe

Description	Thickness (feet)	Depth (feet)
Soil	15	15
Sandstone	2	17
Shale, light gray	13	30
Limestone	15	45

Table 6. *(Continued)*

Well We-114

Owner: Nick Secizzel

Description	Thickness (feet)	Depth (feet)
Shale	20	20
Limestone	5	25
Shale, blue	8	33
Shale, red	35	68
Limestone	6	74
Shale, gray	26	100
Sandstone, white	40	140

Well We-127

Owner: Pennsylvania Rubber Company #7

Description	Thickness (feet)	Depth (feet)
No sample	50	50
Sandstone, medium-grained	35	85
Shale, carbonaceous	50	135
Sandstone, white, fine-grained	15	150
Shale, carbonaceous	10	160
Sandstone, white, coarse	10	170
Shale, sandy	80	250
Sandstone, white, coarse	45	295
Shale, gray	25	320
Sandstone, light gray, fine-grained	15	335
Sandstone, buff to white, coarse-grained	50	385
Shale, olive gray	10	395
Sandstone, light gray, shaly	5	400
Shale, dark gray	40	440
Shale, red	22	462

Well We-134

Owner: Reuben Hissem

Description	Thickness (feet)	Depth (feet)
Soil	5	5
Shale	1	6
Coal	4	10
Sandstone and shale	8	18
Shale, yellow	5	23

Table 6. *(Continued)*

Shale, blue	16	39
Shale, black	39	78
Coal	8	86
Clay	23	109
Sandstone, gray	6	115
Sandstone, light gray	14	129
Limestone	7	136
Shale, green and blue	50	186
Shale, blue	10	196
Shale, gray	12	208
Shale, red and green	8	216
Shale, blue	16	232
Limestone	6	238
Shale, blue and green	18	256
Shale, red	24	280
Shale, green	10	290
Sandstone, calcareous	3	293

Well We-137

Owner: Rodman School

Description	Thickness (feet)	Depth (feet)
Soil	1.5	1.5
Sandstone, soft	7.5	9
Sandstone, hard	45	54
Shale, blue	13	67

Well We-138

Owner: Ridgeview School

Description	Thickness (feet)	Depth (feet)
Soil	16	16
Sandstone	10	26
Clay	3	29
Sandstone, dark	7	36
Clay	3	39
Shale, blue	4	43
Sandstone, hard, yellow	5	48

Table 6. *(Continued)*

Well We-139

Owner: J. A. Porch

Description	Thickness (feet)	Depth (feet)
Soil	2	2
Shale, soft	17	19
Shale, gray, some coal at base	14	33
Shale, gray	2	35
Clay	3	38
Shale, gray	8.5	46.5

Well We-140

Owner: M. D. Hoyman

Description	Thickness (feet)	Depth (feet)
Soil	8	8
Shale and clay	12	20
Sandstone, hard	1	21
Clay	10	31
Shale, black	9	40
Clay	4	44

Well We-142

Owner: Frank Hood

Description	Thickness (feet)	Depth (feet)
Soil	14	14
Sandstone	22	36
Sandstone, hard	15	51
Shale, blue	15	66

Well We-144

Owner: Cambria Trust Company

Description	Thickness (feet)	Depth (feet)
Soil	13	13

Table 6. *(Continued)*

Shale, soft	4	17
Clay	3	20
Coal and shale	2	22
Shale, black and yellow	8	30
Clay, white	4	34
Sandstone, hard	8.5	42.5

Well We-145

Owner: George Geary

Description	Thickness (feet)	Depth (feet)
Soil	8	8
Shale, soft	10	18
Sandstone, yellow	4	22
Shale, blue	16	38
Shale, black	14	52
Clay	20	72
Shale, red and blue	8	80
Shale, green	2	82

Well We-151

Owner: Aluminum Company of America

Description	Thickness (feet)	Depth (feet)
Fill	4	4
Clay	5	9
Slag	4	13
Sand and gravel	4	17
Gravel, coarse; sand	13	30
Gravel and sand	6	36
Lignite	1	37
Gravel, coarse; sand	12	49
Gravel, sand and clay	6	55
Gravel, coarse; sand, some clay	9	64
Gravel, coarse; sand	6	70
Sandstone, hard	2	72

Table 6. *(Continued)*

Well We-152

Owner: Aluminum Company of America

Description	Thickness (feet)	Depth (feet)
Fill	10	10
Clay, sandy	6.5	16.5
Gravel and sand	44.5	61
Gravel, blue; sand	11.75	71.75

Well We-153

Owner: Aluminum Company of America

Description	Thickness (feet)	Depth (feet)
Fill	28	28
Sand and gravel	19	47
Boulders and gravel	8	55
Gravel, coarse; and sand	23	78

Well We-154

Owner: Aluminum Company of America

Description	Thickness (feet)	Depth (feet)
Fill	15	15
Sand, brown	4	19
Clay, sandy, yellow	2	21
Gravel and sand	39	60
Clay	1	61
Gravel, coarse, dark gray, sand	13	74
Gravel, dark gray, sand	9	83

Well We-162

Owner: Kenman Hotel

Description	Thickness (feet)	Depth (feet)
Clay	6	6

Table 6. *(Continued)*

Sand	16	22
Clay and shale	12	34
Limestone	2	36
Shale	23	59
Sandstone	3	62
Shale and coal	1	63
Sandstone	12	75
Shale	3	78

Well We-163

Owner: Braeburn Alloy Steel

Description	Thickness (feet)	Depth (feet)
Fill	3	3
Clay, sandy, yellow	13	16
Gravel, coarse; sand	35	51

Well We-164

Owner: Braeburn Alloy Steel

Description	Thickness (feet)	Depth (feet)
Fill	5	5
Clay, sandy, yellow	13	18
Gravel and sand, brown	15	33
Gravel and sand, blue	27	60

Well We-182

Owner: Vandergrift Water Company

Description	Thickness (feet)	Depth (feet)
Soil	15	15
Limestone, shells	3	18
Shale, black	27	45
Clay, gray	13	58

Sandstone, white	77	135
Shale	23	158
Sandstone, white	24	182
Shale	12	194
Limestone	11	205
Limestone, shells	23	228
Shale	7	235
Limestone	8	243
Shale, hard	19	262
Coal	3	265

Well We-197

Owner: National Roll and Foundry

Description	Thickness (feet)	Depth (feet)
No sample	105	105
Limestone, sandy	25	130
Crevice	1	131
Sandstone	25	156
Shale, sandy, gray	19	175
Sandstone, gray	5	180
Shale, dark	5	185
Coal	1	186
Shale, gray	6	192
Clay	9	201

Well We-233

Owner: Pennsylvania Rubber Company

Description	Thickness (feet)	Depth (feet)
No sample	208	208
Shale, dark	117	325
Sandstone	15	340
Shale	5	345
Sandstone, white	15	360
Shale, dark	10	370
Sandstone, friable, white	25	295
Shale, calcareous, greenish gray	9	404

ALLUVIUM

Lithology

Alluvium overlies the bedrock of the major stream valleys in the county. The extent of the alluvium is shown in Figure 6. It consists of rock material transported and deposited by moving water: clay, silt, sand, gravel, and some boulders. Most of the particles have been rounded during transportation.

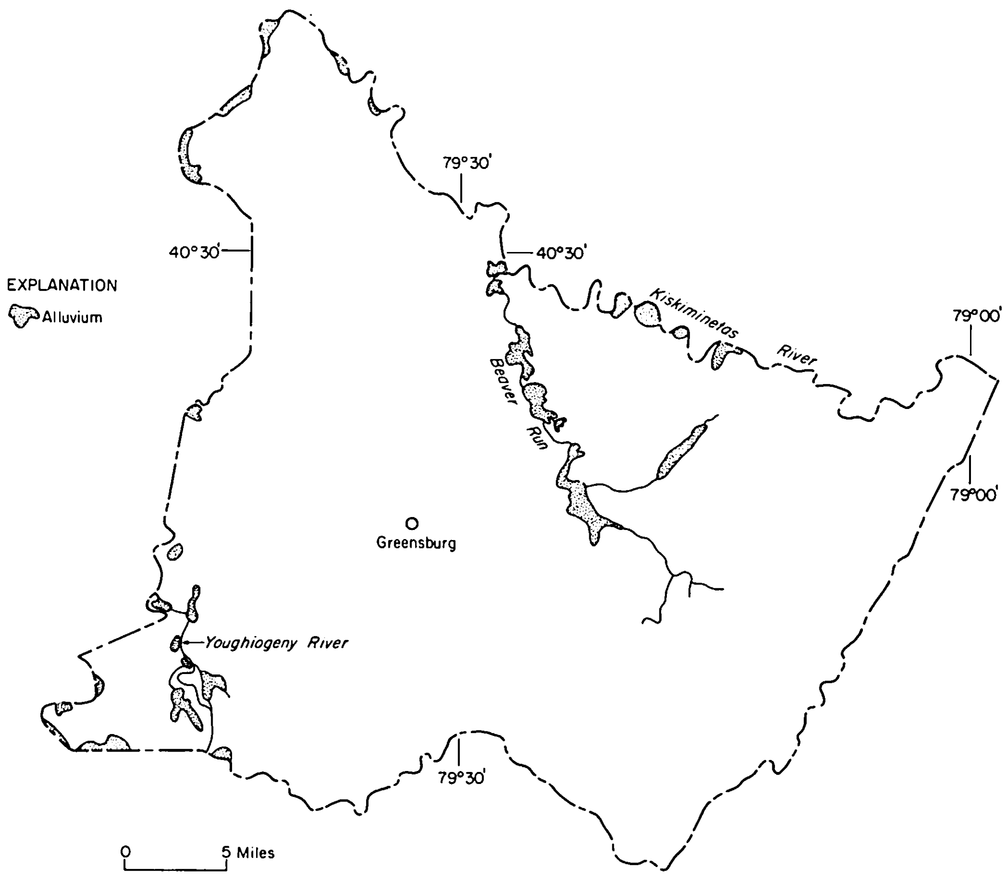


Figure 6. Distribution of alluvium.

The alluvium ranges in texture from poorly sorted to well sorted and occurs as overlapping lenses that may be composed of material of one particle size or a mixture of different particle sizes. Sample logs of wells We-151 and 154 in Table 6 show the vertical variations in texture caused by lensing and differences in sorting.

Water-Bearing Characteristics

Alluvium is generally permeable and, where saturated, will yield moderate to large supplies of water to wells. However, permeabilities may change significantly over short distances because of changes in the degree of sorting. Well yields depend upon the thickness and permeability of the saturated deposits penetrated by the wells. Where alluvium partly fills the valley, that part of the material lower than the stream bed may be recharged by water from the stream when wells are pumped.

Well Depths and Yields

The average yield of 18 wells in the alluvium is 230 gpm, and the range of yields is from 15 to 700 gpm. Specific capacities of wells averaged 16 gpm per foot of drawdown. The well depths in alluvium ranged from 15 to 85 feet, and the average depth was 60 feet. Some of the shallow wells in the alluvium did not penetrate the full thickness of the alluvium. Wells penetrating the full thickness of the alluvium and tapping all the coarse-grained units are likely to be the best wells.

Well Location and Spacing

Proper well location and spacing, of course, are necessary for an efficient well field, and, other factors being equal, full penetration of alluvial aquifers provides maximum yield. Also, wells drilled in a line parallel to and close to a stream may induce recharge from the stream. This is discussed in more detail later in this section.

In areas of heavy pumpage, wells spaced far enough apart to minimize competition between adjacent wells for the available water are ideal. Figure 7 shows the effect on the water table when wells are pumped. To satisfy the demands of both wells the cone of depression (the depression in the water table produced by pumping a well) must be greatly expanded and deepened. By increasing the distance between wells the competition may be reduced to a minimum. Optimum well spacing in alluvium can be established only after determining how the shape of the cone of depression around one or more pumping wells changes with time pumped and with distance from the center of pumping. This information can be obtained from standard pumping tests of developed production and observation wells.

The cone of depression is used to advantage in areas where wells are close to streams. The largest yields in the county are those from wells that tap permeable aquifers that are freely connected with the water in nearby streams. When such wells are pumped at high rates, the cone of depression spreads to the stream, and the ground-water level is lowered to a point below the stream surface. When this occurs, water is induced to move into and through the aquifer from the stream to the well. This process is shown in Figure 8. The water pumped is a mixture of water infiltrated from the stream, water removed from storage in the aquifer, and water entering the aquifer from sources other than the stream.

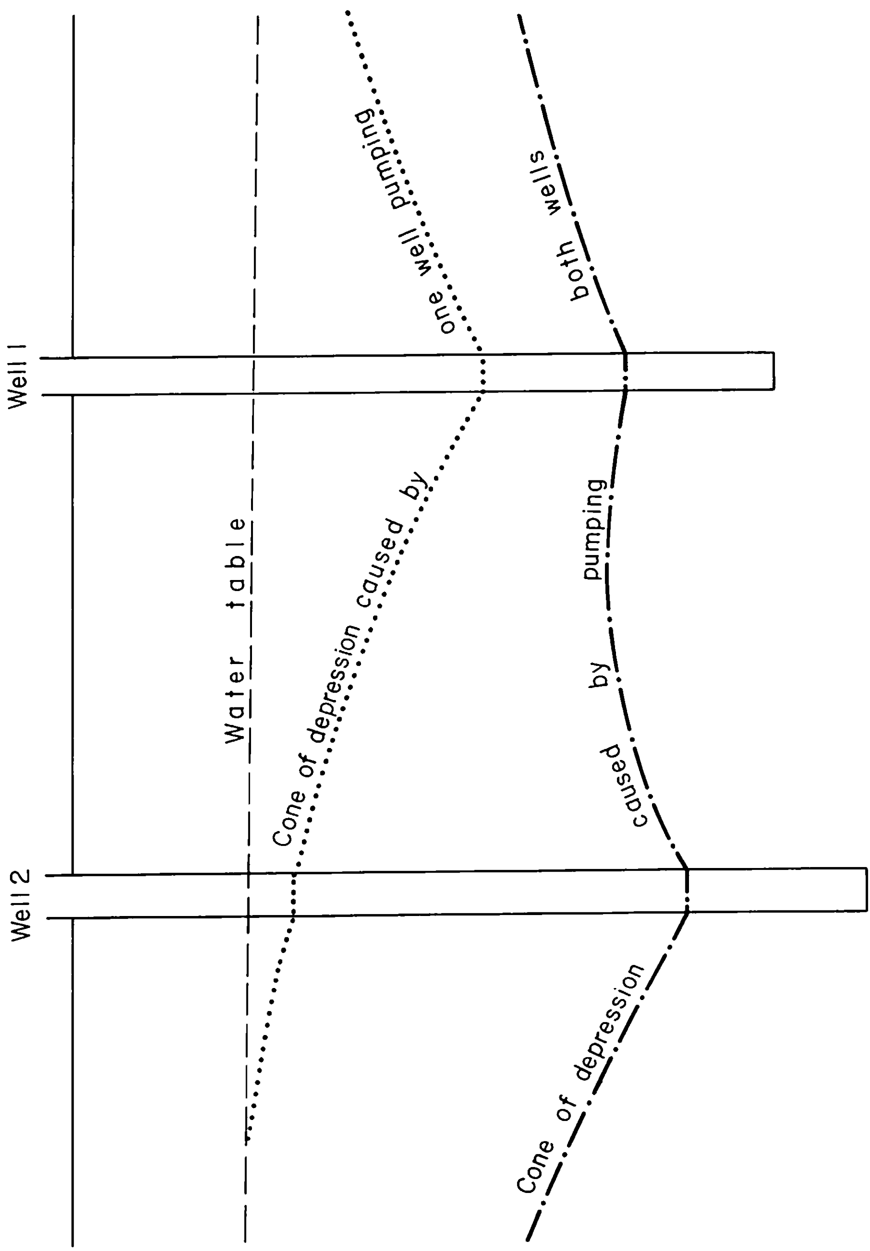


Figure 7. Effects on the water table when wells are pumped.

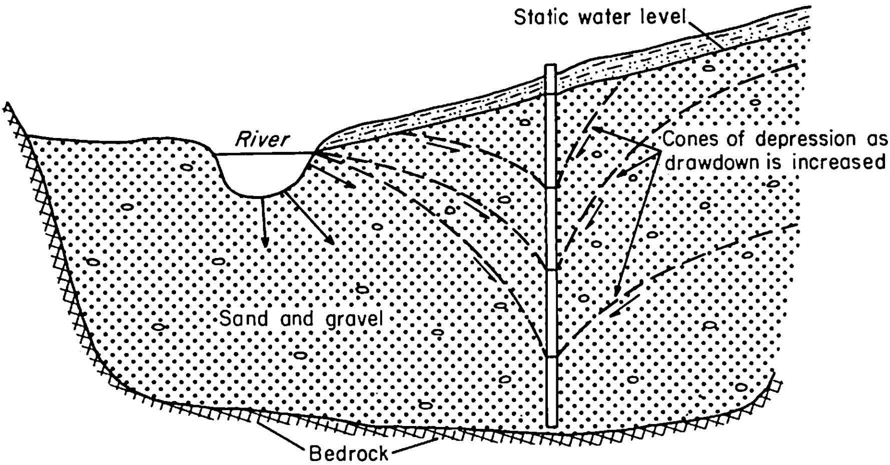


Figure 8. Cones of depression where recharge is induced from a stream.

A line of wells parallel to the stream is superior to any other arrangement. Wells in line B-C of Figure 9 are in the best position to receive induced recharge from the river and to intercept larger amounts of water moving through the aquifer. Because they are aligned at right angles to the regional movement of ground water, the competition for the same water is minimized. The orientation of wells in line A-B, however, is inefficient. Their alignment parallel to the ground-water movement causes the competition for the same water to be maximized.

Water Quality

Water obtained from alluvium is generally hard and has a high iron, manganese, and dissolved-solids content. It also has low turbidity and is usually unpolluted by bacteria. Ground-water temperature approximates the mean annual air temperature of about 53° F. Chemical analyses of water from the alluvium are included in Table 3.

The quality of water from wells changes considerably when water is induced to flow from streams into the cones of influence of wells. When this occurs, the well-water quality is intermediate in character between the quality of the surface water and ground water. Temperature of the mixed waters will be lower during the winter and higher during the summer.

CONSOLIDATED AQUIFERS

The consolidated rocks cropping out in Westmoreland County have an aggregate thickness of about 2,400 feet. The areal extent of the outcrop of each

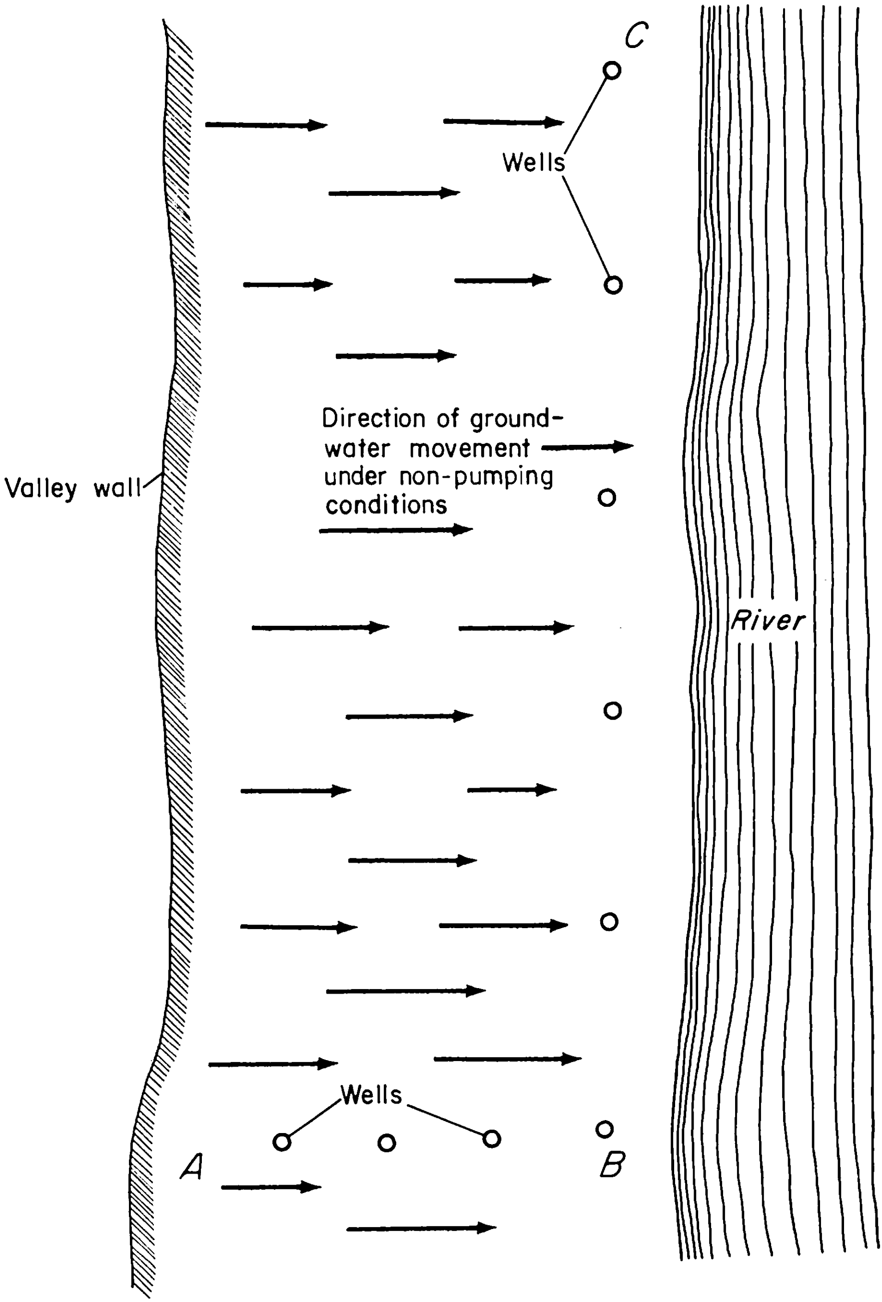


Figure 9. The advantage of placing a line of wells at right angles to the direction of ground-water movement.

geologic unit is shown in Plate 1. Most of the units are composed of sandstone and shale, but there are beds of clay, some thin limestone, and several coal units. Representative logs of wells drilled in bedrock are shown in Table 6. Water-bearing properties of these rocks differ considerably, owing to differences in the kind of rock and its geologic structure, and to differences in altitude relative to local drainage.

WASHINGTON FORMATION

Lithology

The Washington Formation of Permian-Pennsylvanian age consists of alternating beds of shale, sandstone, and coal. There are also some thin-bedded, discontinuous limestone members. The basal member is a fine- to medium-grained sandstone. The Washington Formation has a maximum thickness of about 430 feet.

Water-Bearing Characteristics

In general the Washington Formation is a poor water-bearer. The small outcrop area and the unfavorable topographic position of the outcrops (mostly on top of ridges) limit its importance as a source of water. Where this formation is saturated, the water occurs in joints and along the bedding planes. The basal sandstone yields water in large quantities where it occurs below the stream level.

Well Depths and Yields

The yields of wells in the Washington Formation are low because the fractures are small and scarce. Well yields range from 0.4 to 22 gpm. The highest yield is from a well 430 feet deep, and it is very likely that much of the water is from the underlying formation. Well depths range from 30 to 430 feet. All wells except one are 150 feet or less in depth.

Water Quality

Only one partial chemical analysis of water from the Washington Formation is available. The water is of good quality but moderately hard.

MONONGAHELA GROUP

Lithology

The Monongahela Group of Pennsylvanian age is composed of the Uniontown Formation and the Pittsburgh Formation. These formations, which are undivided on the geologic map, consist of limestone, shale, sandstone, and coal. The limestones are both massive and thin-bedded. The shales and sandstones are discontinuous. There are several minable coal beds in the group, the lowermost being the Pittsburgh coal. The maximum thickness is 187 feet.

Water-Bearing Characteristics

Most of the porosity and permeability in limestone is the result of enlargement of the fractures through the solution and removal of minerals by moving ground water. Permeability of sandstone varies greatly according to grain size, degree of sorting, and amount of cementing material. Secondary porosity may be developed by solution and removal of cementing material or by extensive fracturing. Shale is a fine-grained, rather impermeable rock, but usually contains water in fracture or joint systems that developed from folding and faulting.

Well Depths and Yields

The yields of wells in the Monongahela Group are low because of the smallness and scarcity of fractures. Well yields range from 0.2 to 15 gpm, and the average yield is about 3 gpm. Yields greater than those required for domestic purposes are not available from wells in this formation. Large-diameter wells will yield larger volumes of water than smaller ones for short periods because their storage capacity is greater. Aside from the storage factor, deeper wells in the Monongahela Group do not yield significantly more water than shallower wells. The low yields are partly the result of the dewatering of the rocks by coal mining.

Well depths range from 23 to 265 feet, and most of the wells are less than 110 feet deep.

Well Location and Spacing

Locating an adequate water supply in the Monongahela Group is very difficult for the reasons stated in the preceding section. It might be possible to develop small household supplies from isolated perched water zones that may occur above the less permeable layers of the group.

Water Quality

Water in the Monongahela Group is largely of the calcium bicarbonate type. Dissolved solids range from 272 to 610 mg/l. Iron ranges from 0.08 to 35 mg/l.

CONEMAUGH GROUP

Lithology

The Conemaugh Group of Pennsylvanian age is composed of the Casselman and Glenshaw Formations. It is much less calcareous than the overlying Monongahela Group and consists primarily of sandstone and shale and lesser amounts of limestone and coal. The Conemaugh Group is by far the most extensive of the Pennsylvanian formations within the county. The group covers the entire western part of the county except for the deepest parts of the structural troughs, where it is covered by younger formations, and a few scattered anticlinal axes, where it has been eroded away and older rocks crop out. In the eastern part of the county the Conemaugh Group crops out in the Ligonier syncline. It reaches a maximum thickness of 640 feet.

Water-Bearing Characteristics

The best water-producing formations in the Conemaugh Group are the sandstones. Well yields depend on local permeability of the aquifers and whether or not the sandstones are drained. Water occupies the void spaces between the sand grains and the fractures in the sandstone.

In the shale and limestone members, water generally occupies bedding and joint planes, especially near the axes of the folds.

Well Depths and Yields

The Conemaugh Group is a reliable source of small to moderate supplies of water. Some wells yield more than 100 gpm, but the median yield for wells in this aquifer is 20 gpm. The deepest water well reported in the Conemaugh Group was drilled 640 feet and produced 25 gpm. The highest reported yield was 357 gpm from a well 176 feet deep.

Sufficient water for domestic purposes can be obtained at almost any location from wells that are drilled 100 to 150 feet below the water table, but yields large enough for industrial and municipal purposes are more difficult to obtain. Test drilling, at least, would be necessary to find the best site for a large production well.

Well Location and Spacing

Spacing is generally not critical for domestic wells but may be critical for industrial and municipal wells. Where several pumping wells are closely spaced, the cones of depression overlap; consequently, drawdown is increased and the yield of each well is reduced. Wells less than 500 feet apart in the Conemaugh Group generally interfere with each other when pumped simultaneously.

Water Quality

Chemical analyses of ground water in the Conemaugh Group show a wide range in chemical character. The range of dissolved solids is from 99 to 722 mg/l. The range in hardness is from 10 to 263 mg/l. Iron ranges from 0.08 to 23.2 mg/l. The upper limit for iron is 0.3 mg/l (U.S. Public Health Service, 1962).

ALLEGHENY GROUP

Lithology

The Allegheny Group of Pennsylvanian age is composed of the Freeport Formation, Kittanning Formation, Vanport Limestone, and Clarion Formation.

The group consists of shale, sandstone, discontinuous limestone, and coal beds. Shale constitutes the greater part of the Allegheny Group, and sandstone varies widely in thickness and degree of sorting and may be absent in some sections. The principal outcrop areas of the Allegheny Group lie along Chestnut Ridge and Laurel Hill. The rocks are exposed in a sinuous band along the flanks of these ridges. There are several other small areas of outcrop in some of the major stream valleys and along the crest of the Grapeville anticline. The maximum thickness may reach 400 feet.

Water-Bearing Characteristics

Ground water moves through fractures and pore spaces in the Allegheny Group. In the shaly facies water is contained in the joints and bedding plane passages. The best water-bearing units of the group are beds of sandstone that are lenticular and discontinuous; thus, well yields may differ considerably from place to place. The yields will be small and drawdown will be rather large in wells that do not penetrate sandstone.

Well Depths and Yields

The Allegheny Group is a reliable source of small to moderate supplies of water. Two wells completed in this aquifer have large yields. Wells We-127 and 182, tapping sandstone, yield 300 gpm and 550 gpm, respectively. The average well yield for the Allegheny Group is 5 gpm. Sufficient water for domestic purposes can be obtained at most locations from wells that are drilled 100 feet below the water table, but yields large enough for industrial or public supply are very difficult to obtain. Test drilling, at least, would be necessary to find the best site for a large production well.

Well Location and Spacing

Spacing is generally not critical for domestic wells in the Allegheny Group, but is critical for large industrial and municipal wells.

Water Quality

One partial chemical analysis (Table 3) is available for water from the Allegheny Group, and it shows the water to be hard, high in iron, and high in chloride and dissolved solids.

POTTSVILLE GROUP

Lithology

The Pottsville Group is composed of the Homewood, Mercer and Connoquenessing Formations.[1] It consists predominantly of sandstone, conglomerate, and thin beds of shale. The sandstone is generally loosely cemented and very permeable, but there are areas where permeability is low.

Water-Bearing Characteristics

Water in the Pottsville Group occurs in the pore spaces between the grains and in the secondary openings (such as fractures) in the rock. The size of the openings between the grains differs with the degree of sorting of the original material and with the amount of cementation that binds the grains together. The Pottsville Group in this area is coarse grained, well sorted, lightly cemented, and yields moderate to large amounts of water to wells.

Well Depths and Yields

The yield of a well in the Pottsville Group depends partly upon its depth. A well that fully penetrates the sandstone will yield more water than a partially penetrating well. Few data are available for wells in this aquifer, but the deepest has the highest yield (500 gpm) and the shallowest has the lowest yield (20 gpm). The yields of two wells believed by the author to penetrate the full thickness of the sandstone are 250 and 500 gpm.

Well depths in the Pottsville Group range from 64 to 450 feet.

Well Location and Spacing

Wells drilled in the Pottsville Group ideally would be located where they will penetrate the greatest saturated thickness of the most permeable beds. The Pottsville Group is exposed along the Chestnut Ridge anticline and on the west side of Laurel Hill, so that wells located to tap only these rocks would have to be drilled on the sides or near the tops of these hills.

Water Quality

Analyses of water from three wells tapping the Pottsville Group and overlying rocks are presented in Table 3. The three analyses show the water to be high in iron, and water from the deeper wells is high in chloride and dissolved solids.

[1] These formation names do not conform to the nomenclature used by the Pennsylvania Geological Survey. For a discussion of the stratigraphy of the Pottsville Group in western Pennsylvania, see Edmunds, W. E. (1969), *Revised lithostratigraphic nomenclature of the Pottsville and Allegheny Groups (Pennsylvanian), Clearfield County, Pennsylvania*, Pa. Geol. Survey, 4th ser., Inf. Circ. 61, 36 p.; Ashley, G. H. (1945), *The Pittsburgh-Pottsville boundary*, Jour. Geology, v. 53, p. 374-389; and Renick, B. C. (1924), *The correlation of the Allegheny-Pottsville section in western Pennsylvania*, Jour. Geology, v. 32, p. 64-80.

The maximum concentration of chloride is 1,200 mg/l from a well 404 feet deep.

MAUCH CHUNK FORMATION

Lithology

The Mauch Chunk Formation of Mississippian age consists of red, gray, or green shale interbedded with several limestone and sandstone members. The formation crops out only along the higher ridges in eastern Westmoreland County and is buried at considerable depth in the other parts of the county. It is about 310 feet thick.

Water-Bearing Characteristics

The beds of the Mauch Chunk Formation are generally water bearing where they are saturated or lie beneath other saturated formations. However, the available information on the Mauch Chunk in Westmoreland County is too sparse to make an accurate appraisal of its water-bearing characteristics.

Well Depths and Yields

Data are available for one well in the Mauch Chunk Formation. This well is 615 feet deep and yields 2½ gpm.

Well Location and Spacing

No information is available for Westmoreland County.

Water Quality

No data are available in Westmoreland County on the chemical quality of the water from the Mauch Chunk Formation.

POCONO GROUP

Lithology

The Pocono Group of Mississippian age is composed of massive beds of sandstone, locally conglomeratic, and some dark shale. There are only a few scattered exposures of these rocks along the crest of Laurel Hill and Chestnut Ridge.

Water-Bearing Characteristics

Water in the Pocono Group occurs in the pore spaces between the grains and in the secondary openings (such as fractures). The size of the openings between the grains differs with the degree of sorting of the original material and with the amount of cementation that binds the grains together. The beds of shale retard the downward movement of water and are poor water-bearing units.

Well Depths and Yields

In the outcrop areas of the Pocono Group there are many hillside springs, some of which discharge more than 100 gpm. Drilled wells are few, although well We-21 is representative. This well penetrates several overlying aquifers, but the water-bearing zone(s) have not been determined. The Pocono Group is deeply buried throughout most of the county and is reached only in the deeper wells.

Well Location and Spacing

Data concerning well location and spacing are lacking.

Water Quality

In the western part of the county, the rocks of the Pocono Group are generally buried more than 500 feet deep, or more than 100 feet below the level of the major streams. Wells drilled into these rocks usually encounter salt water. In the Allegheny Mountain section, in the eastern part of the county, the Pocono Group is at shallower depths and is usually saturated with good-quality water. Any fresh water in the Pocono occurs in this area.

HOW MAN HAS CHANGED THE HYDROLOGIC SYSTEM

PRESENT STATUS OF DEVELOPMENT OF WATER SUPPLIES

Population and industrial growth of the county have greatly altered water demands and the means of satisfying those demands. In the early days, the county people had their own wells or obtained their water supplies from nearby springs or streams. By the late 1960's, 85 percent of the population received water from public water-supply facilities. An inventory in 1970 indicated that public-supply use averaged 119 mgd (million gallons per day). Of this total, 3 mgd was from ground-water sources.

No recent inventory of commercial and industrial water supplies has been made, but the amount of ground water used for most purposes has probably decreased. The overall decline is due to improved plant design and to the use of more efficient manufacturing techniques. The water is used primarily for cooling and processing, and about one-fourth of it is reused. Water requirements of some companies have been reduced to the point where it is more economical to purchase water than to maintain wells.

GROUND-WATER PUMPAGE

Reports from three municipalities using ground water in Westmoreland County indicate that about 400,000 gpd is being pumped from wells or obtained from springs.

New Alexandria pumps four wells and obtains about 220,000 gpd. Avonmore pumps 11 wells that yield 170,000 gpd. The village of Fritz Henry gets 5,000 gpd from springs. As stated above, no recent inventory of industrial supplies has been made, but there has probably been a decrease in the amount of ground water used for most purposes.

SURFACE-WATER PUMPAGE

The water supplies for most of the municipalities in Westmoreland County are obtained from surface-water sources. Available data indicate that 119 mgd are used to supply the municipalities in the county. Surface-water supplies are taken from reservoirs on many smaller streams and directly from the larger streams.

WATER PROBLEMS RESULTING FROM THE ACTIVITIES OF MAN

COAL MINING

The greatest water problem in Westmoreland County is the contamination of the water resources by drainage from coal-mining operations. The waste material left behind during the removal of coal is rich in sulfur-bearing minerals. Exposure of these minerals to air and water produces sulfuric acid, which may be temporarily pooled in the mine areas or may move directly into streams. Wells that are near such areas and are open at or below the level of these pools will tap water contaminated by sulfuric acid.

Streams draining coal-mining areas are contaminated to varying degrees. The Allegheny, Conemaugh, Kiskiminetas, Loyalhanna, and Monongahela Rivers and many of their tributaries carry mine drainage.

The many reservoirs in watersheds of streams entering Westmoreland County benefit the area in two ways. They diminish potential flood hazards by retaining much of the excess water during periods of high surface runoff. They also reduce the degree of contamination by releasing water during periods of low river stage, thus diluting the otherwise highly mineralized streams.

DEWATERING OF AQUIFERS

Collapse of unsupported roof material in worked-out coal mines has caused fracturing and dewatering of the overlying aquifers in some parts of the county.

In the northwestern part of the county, the Pittsburgh sandstone, overlying the Pittsburgh coal, has been extensively dewatered wherever that coal has been mined. In other parts of the county, similar drainage of the sandstone occurs above mines in the Upper Freeport coal.

OIL AND GAS WELLS

Oil and gas production in the county today is of relatively minor significance, but it once was a major industry. During the search for oil and gas, thousands of wells were drilled. Many of the well casings have been removed or severely corroded. The result is that salt water under artesian pressure has, in many areas, moved up the boreholes and out into the shallower freshwater aquifers.

DEVELOPMENT OF WELLS

DRILLING METHODS

Dug wells were common around the turn of the century, but they now are a rarity. Most wells currently in use in Westmoreland County are drilled by percussion or rotary methods. In the percussion or cable-tool method, wells are drilled by the alternate lifting and dropping of a heavy drilling bit in the borehole. The bit action breaks up consolidated rock material or loosens unconsolidated material so that the smaller fragments may be removed with a bailing device. The rotary method uses a rotating bit to cut rock or to loosen alluvial material; drill cuttings are carried from the borehole to the surface by circulating water, drilling mud, or air.

WELL CONSTRUCTION

Wells generally are cased with pipe to prevent collapse of the borehole. In consolidated material the casing may be driven only a few feet into the rock, or may line the hole to very near its bottom. In unconsolidated materials, casing must be used to prevent collapse of the hole, and it is common practice to replace the casing with screen opposite water-bearing zones. An alternative to a screen is slots or drill holes cut into the casing. The purpose of the screen or slotted casing is to allow entry of water into the well while excluding the rock material. Gravel packing is a further refinement for construction of wells in alluvium. In this technique, clean coarse gravel is used to fill the annular space between the well screen and the outside of the borehole. The purpose of a gravel pack is to increase the effective screen diameter, reduce the entrance velocity of water entering the well, and lessen the likelihood that fine sand will clog the well screen.

In the interest of sanitation it is necessary to fill the upper part of the annular space between the casing and the earth with grouting material, such as concrete. The grout extends down far enough to prevent the entry of surface pollutants into the zone of water withdrawal.

WELL DEVELOPMENT

The method commonly used to increase well yields consists of heavy pumping of the borehole for a short period of time to remove drill cuttings and fine material from the water-bearing zones. Other less common techniques used to increase yields are mechanical surging and the addition of detergents.

Mechanical surging is similar to operating a piston in a cylinder, with the casing or well bore acting as the cylinder and the surge block as the piston. Alternately raising and lowering the block in the well forces water in and out of the openings in the aquifer. Loose rock chips or fine sand grains are loosened and drawn into the well bore, from which they may be pumped after surging. This method is most successful in unconsolidated material, sandstone and conglomerate.

Detergents can be used most successfully in wells where clay and silty materials plug small fractures and other openings in the aquifer. The detergent helps to break up these plugs into small particles so that they may be pumped out, leaving the aquifer openings clear to transmit more water to the borehole.

MANAGEMENT OF WATER SUPPLIES

PROTECTION FROM OVERDRAFT

Overdraft can occur when water levels in wells drop below the pumps and production ceases or becomes inadequate. Possible remedies are reduction of pumpage, addition of recharge, additional wells, better well spacing and orientation of additional wells, and lowering of pump-intake settings.

Since there is relatively little use of ground water in Westmoreland County, there is no known overdraft. Overdraft would be most likely where wells are spaced close together or in areas distant from streams, where induced infiltration is not possible.

PROTECTION FROM POLLUTION

Water moves rather freely between the surface and subsurface; therefore, conditions which affect the quality of surface water may also affect the quality of ground water. The reverse is also true. This interrelation is most apparent in heavily industrialized areas, where large amounts of waste are discharged into rivers and much river water is induced into nearby wells that are producing from the river alluvium. River water contamination is generally highest during the time of greatest ground-water pumpage and this can (and in many cases does) adversely affect the quality of water yielded by such wells.

Government agencies are becoming increasingly active in the field of pollution prevention. The Pennsylvania Department of Health has set standards for length and cementing of casing in wells, and the Pennsylvania Department of Environmental Resources has established regulations concerning the reclamation of strip mines to reduce the formation of acid water. As mentioned previously, however, the discharge from abandoned strip and deep mines is still a major source of pollution. Snowmelt and heavy rains throughout the year flush out the acid water accumulated in the mines and carry it into the streams. When this happens, dilution by less mineralized water reduces the degree of contamination.

A large part of the ground water used by industry is for cooling purposes. After use, much of this warmer water is discharged to streams. The higher temperature makes the water less suitable for similar use in downstream areas.

Ground-water supplies may be polluted by material carried downward from the land surface by infiltrating water. Because ground water moves slowly, such pollution is slow to accumulate and just as slow to flush out after the source is removed. Common sources of pollution are septic systems, nitrate from fertilizers, and household detergents; other sources are industrial wastes, accidental oil spills, sanitary landfills, and mine water discharge.

In the future, controlling the water quality probably will be a greater problem than obtaining sufficient quantities of water. Surface-water quality is now monitored at many points in Westmoreland County. A similar system to monitor the quality of ground water in and around cities, industrial sites, and unpopulated areas would be valuable.

WHERE TO GET INFORMATION ABOUT WATER

The Pennsylvania Topographic and Geologic Survey has information on the geology of Westmoreland County and has published reports describing the aquifers and chemical quality of ground water. Well drillers' logs and reports on new wells also are available.

The Private Water Supply section, Division of Sanitation, Pennsylvania Department of Health can supply information on proper well construction, biological reports on well water, and the chemical quality of ground water in this and other counties. The Pennsylvania Department of Health, through various regional offices, can test water samples for bacterial pollution; they also can advise on corrective measures to be taken when pollution is reported.

The Engineering and Construction section of the Pennsylvania Department of Environmental Resources has information on some municipal water supplies, including source, average daily use, total annual use, and estimated future needs.

The U.S. Geological Survey has data on wells, springs, and streams and on the chemical quality of water.

When requesting information on water supplies, an accurate location of the site should be given. This will help the above-listed agencies to give assistance and advice.

Local well drillers and pump installers can provide prices and suggest the type of equipment needed to develop a water supply. The drillers may know the well depth necessary to obtain desired yields and how much surface casing is required. They can also suggest the proper well diameter for the desired pumping equipment. Pump installers can supply information concerning the size of the pump, depth of the pump setting, and the pressure-tank capacity.

If chemical analysis of the well water indicates treatment is necessary, commercial water-treatment companies can provide the necessary information and equipment. Equipment for water treatment can be purchased or rented, and it will be serviced by the supplier if desired.

GLOSSARY

Anticline: An arch in stratified rock in which the layers bend downward in opposite directions from the crest and which has the oldest rocks in the core; reverse of syncline.

Aquifer: A formation, group of formations, or a part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian water: Ground water that occurs under sufficient hydrostatic head to rise above the level at which it was encountered in a well.

Cubic feet per second: The rate of discharge equivalent to the discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, whose velocity is 1 foot per second; equivalent to 448.8 gallons per minute.

Cone of depression: A funnel-shaped depression on a water table or potentiometric surface centered at a pumping well or other discharge point.

Drainage, or drainage level: In this report, refers to the level of the beds of the principal streams.

Drainage system: A stream and its tributaries.

Direct runoff: The water that moves over the land surface directly to streams immediately after rainfall or snowmelt.

Discharge, ground-water: The water that leaves the zone of saturation.

Evapotranspiration: Water withdrawn from a land area by direct evaporation from water surfaces and moist soil and by plant transpiration.

Fracture: Breaks in rocks due to applied stresses.

Ground-water reservoir: An aquifer or a group of related aquifers.

Head, static: The height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point.

Induced infiltration: The process through which the cones of depression are lowered to a point where they intercept the water of a perennial stream, reversing the normal direction of the ground-water gradient; also, the water drawn into the aquifer by this process.

Joint: A fracture opened with no displacement of adjacent walls along the fracture; often vertical and occurring in sets crossing each other at high angles.

Perched ground water: Ground water separated from an underlying body of ground water by an unsaturated zone. It is under water-table conditions.

Permeability: The capacity of a porous medium to transmit a liquid.

Plunge: The inclination of the crest of geologic structures (as anticlines and synclines) from a horizontal plane.

Potentiometric surface: The surface to which the water from a given aquifer will rise under its full head. The surface represents the static head. It is defined by the levels to which water will rise in tightly cased wells.

Recharge, ground-water: The process by which water is added to the zone of saturation.

Runoff: That part of precipitation that appears in streams.

Saturated zone: The zone in which interconnected interstices are saturated with water under pressure equal to or greater than atmospheric.

Specific capacity: The rate of discharge of water from a well, in gallons per minute, divided by the drawdown of water level in the well, in feet. It varies slowly with duration of discharge.

Stream-gaging station: A gaging station where a record of discharge of a stream is obtained. Within the Geological Survey this term is used only for those gaging stations where a continuous record of discharge is obtained.

Surface water: Water on the surface of the earth.

Syncline: A trough in stratified rock in which the layers dip toward each other from either side, and which has the youngest rocks in the core.

Transpiration: The quantity of water absorbed and transpired and used directly in the building of plant tissue in a specified time; also the process by which water vapor escapes from the living plant, principally the leaves, and enters the atmosphere.

Water table: That surface in an unconfined water body at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body.

Water-table conditions: The conditions under which water occurs in an aquifer that is not overlain by an impermeable body and that has a water table.

REFERENCES

Baldwin, H. L. and McGuinness, C. L. (1963), *A primer on ground water,* U.S. Geol. Survey Misc. Ser., 26 p.

Becher, A. E. (1971), *Ground water in Pennsylvania,* Pa. Geol. Survey, 4th ser., Educational Ser. 3.

Busch, W. F. and Shaw, L. C. (1966), *Pennsylvania streamflow characteristics, low-flow frequency and flow duration,* Pa. Dept. Forest and Waters, Bull. 1, 290 p.

Gray, Carlyle and others (1960), *Geologic map of Pennsylvania,* Pa. Geol. Survey, 4th ser., Map 1, 1:250,000.

Hem, J. D. (1959), *Study and interpretation of the chemical characteristics of natural water,* U.S. Geol. Survey Water-Supply Paper 1472, 269 p.

Johnson, M. E. (1925), *Mineral resources of the Greensburg quadrangle,* Pa. Geol. Survey, 4th ser., Atlas 37, 163 p.

Leopold, L. B. and Langbein, W. B. (1960), *A primer on water,* U.S. Geol. Survey Misc. Ser., 50 p.

Pennsylvania Department of Health (1961), *Construction standards for individual water supplies,* Division of Sanitation.

Piper, A. W. (1933), *Ground water in southwestern Pennsylvania,* Pa. Geol. Survey, 4th ser., Bull. W1, 406 p.

U.S. Dept. of Health, Education and Welfare (1962), *Drinking water standards,* Public Health Service Pub. 956, 61 p.

____________, (1964), *Municipal water facilities, 1963,* Public Health Services, Pub. 775 (revised), v. 2, 169 p.

U.S. Geological Survey, *Surface water records of Pennsylvania,* issued annually.